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ABSTRACT

"New Standards" is a collaboration between the Learning Research and Development Center and the National Center on Education and the Economy, in partnership with states and urban districts, working to build an assessment system with which to measure students' progress toward meeting national standards at internationally benchmarked levels. The New Standards assessment system has three interrelated components: (1) performance standards; (2) an on-demand examination; and (3) a portfolio system. Standards are provided for English Language Arts, Mathematics, Science, and Applied Learning at the elementary school level. (Contains 22 references.) (ASK)

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ED 434 797

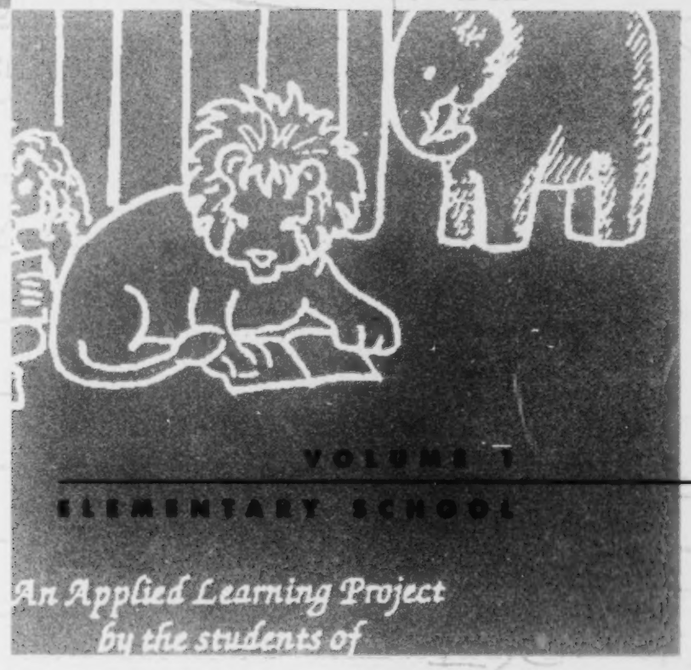
PERFORMANCE STANDARDS

English Language Arts

Mathematics

Science

Applied Learning



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NEW
STANDARDS

Consultation Draft

PERFORMANCE STANDARDS

English Language Arts

Mathematics

Science

Applied Learning

VOLUME 1

ELEMENTARY SCHOOL

NEW
STANDARDS

Consultation Draft

Support for the development of these Performance Standards was provided by:

The Pew Charitable Trusts,
John D. and Catherine T. MacArthur Foundation,
and the
New Standards' Partners

RESPONDING TO THIS DRAFT

We welcome your response to this Consultation Draft.
A Comments and Feedback Form is enclosed.
Responses need to reach us no later than 3 May 1996 to be considered
in the preparation of the next version of these Performance Standards.
Additional Comments and Feedback Forms can be obtained by contacting
New Standards, LRDC, University of Pittsburgh, 3939 O'Hara Street,
Pittsburgh, PA 15260; Tel. 412-624-8319; Fax. 412-624-1470;
dedwards@vms.cis.pitt.edu.

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Introduction

ABOUT NEW STANDARDS

New Standards is a collaboration of the Learning Research and Development Center of the University of Pittsburgh and the National Center on Education and the Economy, in partnership with states and urban districts, working to build an assessment system to measure their students' progress toward meeting national standards at levels that are internationally benchmarked.

The Governing Board includes chief state school officers, governors and their representatives, and others representing the diversity of the partnership, whose jurisdictions enroll nearly half of the Nation's students.

Founded by Lauren Resnick, Director of the Learning Research and Development Center (LRDC), and Marc Tucker, President of the National Center on Education and the Economy, New Standards' staff is based at these organizations as well as the American Association for the Advancement of Science, the Fort Worth Independent School District, the National Council of Teachers of English, and the University of California Office of the President. Technical studies are based at LRDC and Northwestern University, advised by leading psychometricians from across the nation.

The New Standards' assessment system has three interrelated components: performance standards, an on-demand examination, and a portfolio system.

The **performance standards** are derived from the national content standards developed by professional organizations, e.g., the National Council of Teachers of Mathematics standards in Mathematics, and consist of two parts:

Performance descriptions—descriptions of what students should know and the ways they should demonstrate the knowledge and skills they have acquired in the four areas assessed by New Standards—English Language Arts, Mathematics, Science, and Applied Learning—at elementary, middle, and high school levels.

Work samples and commentaries—samples of student work selected for their capacity to illustrate the meaning of the performance descriptions together with commentary that shows how the performance descriptions are reflected in the work sample.

The performance standards were endorsed unanimously by the New Standards' Governing Board in June 1995 for widespread consultation in 1995–96.

The on-demand examination, called the **reference examination** because it provides a point of reference to national standards, is currently available in English Language Arts and Mathematics at grades 4, 8, and 10. It assesses those aspects of the performance standards that can be assessed in a limited time frame under standardized conditions. In English Language Arts, this means reading short passages and answering questions, writing first drafts, and editing. In Mathematics, this means short exercises or problems that take five to fifteen minutes and longer problems of up to forty-five minutes' duration. The reference examination stops short of being able to accommodate longer pieces of work—reading several books, writing with revision, conducting investigations in Mathematics and Science, and completing projects in Applied Learning—that are required by New Standards' performance standards and the national consensus content standards from which they are derived.

The **portfolio system** complements the reference examination, providing evidence of the performance standards that depend on extended pieces of work (especially those that show revision) and accumulation of evidence over time. In 1994–95, using draft portfolio handbooks in English Language Arts and Mathematics, 3,000 teachers and almost 60,000 students participated in a field trial of the portfolio system. In addition to handbooks for students, teachers, and administrators, the current system provides example portfolios that contain concrete examples of expectations for students and teachers.

This year the portfolio system trial is being extended to include Science and Applied Learning. The system has been revised to take account of the experience of the first year, with the goal of making it easier to understand and implement.

ABOUT THE PERFORMANCE STANDARDS

We have adopted the distinction between content standards and performance standards that is articulated in *Promises to Keep: Creating High Standards for American Students* (1993), a report commissioned by the National Education Goals Panel. Content standards specify "what students should know and be able to do;" performance standards go the next step to specify "how good is good enough."

These standards are designed to answer the question: how good is good enough?

Where do the standards come from?

The standards are built directly upon the consensus content standards developed by the relevant professional organizations. The Mathematics standards are based directly on the content standards produced by the National Council of Teachers of Mathematics (1989). Similarly the standards for English Language Arts are being developed in concert with the content standards currently being produced by the National Council of Teachers of English and the International Reading Association.

The Science standards are founded both upon the American Association for the Advancement of Science's Project 2061 *Benchmarks for Scientific Literacy* (1993) and the National Research Council's *National Science Education Standards draft,* (1995). The Science standards will also take into account the work of the National Science Teachers Association as they revise their *Scope, Sequence, and Coordination Content Core* (1992) and develop assessment tasks.

The case of the Applied Learning standards is a little different. Applied Learning focuses on the requirements for effective participation in the emerging forms of work and work organization characterized by high performance work places. As a newer field of school education, Applied Learning does not yet have a distinct professional constituency producing content standards on which the performance standards can be built. However, a start has been made by the work of the Secretary's Commission on Achieving Necessary Skills which defined "Workplace Know-how" in its report, *Learning a Living: A Blueprint for High Performance* (1992). We have worked from this foundation and from comparable work internationally to produce our own *Framework for Applied Learning* (New Standards, 1994). The Applied Learning standards are being built upon this draft framework.

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Standards for Standards

In recent years several reports on standards development have established "standards for standards;" that is, a set of guidelines for developing standards and criteria for judging their quality. These include the review criteria included in *Promises to Keep*, the American Federation of Teachers' "Criteria for High Quality Standards," published most recently in *Making Standards Matter* (1995), and the "Principles for Education Standards" developed by the Business Task Force on Student Standards and published in *The Challenge of Change* (1995). The headings below are borrowed or adapted from the criteria and principles advocated in those documents.

Standards should establish high standards for all students.

The New Standards' partnership has resolved to abolish the practice of expecting less from poor and minority children and children whose native language is not English. These standards are intended to help bring all students to high levels of performance.

Much of the onus for making this goal a reality rests on the ways the standards are implemented, but part of it lies in the design of the standards themselves. We are working to make the expectations included in the standards as clear as possible. For some standards it has been possible to do this in the performance descriptions. For example, the reading standard includes expectations for students to read widely and deeply. Instead of simply exhorting them to do this, we have given more specific direction by specifying that reading includes at least twenty-five books each year, books of the quality and complexity illustrated in the sample reading list for each grade level. In Mathematics, we have gone beyond simply listing problem solving among our expectations for students. In addition, we set out just what we mean by problem solving and what things we expect students to be able to do in problem solving and mathematical reasoning.

What distinguishes these standards from most others is the use of samples of student work to illustrate what they mean, especially for standards that are hard to pin down clearly in words alone. In the writing standard, for example, the work samples show the expected qualities of writing in the various genres as well as criteria for assessment matched to the genres.

The work samples are intended to be used by teachers, students, and parents, to help them picture work that meets standards and to establish goals to reach for. Students need to know what work that meets standards looks like if they are to strive to produce work of the same quality. They also need to see themselves reflected in the work samples if they are to believe that they too are capable of producing such work. We have taken care to include work samples drawn from a diverse range of students.

Standards should be rigorous and world class.

Is what we are asking of our students as rigorous and demanding as what is expected of young people in other countries—especially those countries whose young people consistently perform as well as or better than ours?

That is the question we are trying to answer when we talk about developing world class standards.

Throughout development of the standards, we have compared them with national and local curricula of other countries, textbooks, assessments, examinations and, where possible, with student work. Ultimately it is in the work that students produce that we will discover whether claims for world class standards can be supported.

We have shared the standards with researchers in several countries and asked them to review them in terms of their own country's standards and in light of what is considered world class in their field. We have asked these reviewers to tell us whether each standard is at least as demanding as its counterparts abroad and whether the set of standards represents an appropriately thorough coverage of material.

The information collected so far indicates that the standards we are defining are world class. To show this we have included "world class connections" throughout this volume. World class connections are examples of the work students in selected countries are expected to do. They are included to allow comparison with these performance standards.

Standards should be useful, developing what is needed for citizenship, employment and life-long learning.

The core disciplines provide the strongest foundation for learning what is needed for citizenship, employment, and life-long learning. We have established explicit standards in each of the core areas of English Language Arts, Mathematics, and Science. But there is more. In particular, it is critical for young people to achieve high standards in Applied Learning—the fourth area we are working on.

Applied Learning is about the capabilities people need to be productive members of society, as individuals who apply the knowledge gained in school and elsewhere to analyze problems and propose solutions, to communicate effectively and coordinate action with others, and to use the tools of the information age workplace.

Applied Learning is not about "job skills" for students who are judged incapable of, or indifferent to, the challenges and opportunities of academic learning. They are the kinds of abilities all young people will need, both in the workplace and in their role as citizens. They are the thinking and reasoning abilities demanded by both colleges and the growing number of high performance workplaces, those that expect employees at every level of the organization to take responsibility for the quality of products and services. Some of these abilities are familiar; they have long been recognized goals of schooling, though they have not necessarily been translated clearly into expectations for student performance. Others break new ground; they are the kinds of abilities we now understand will be needed by everyone in the near future. All are skills attuned to the real world of responsible citizenship and dignified work that values and cultivates mind and spirit.

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Standards should be important and focused, parsimonious while including those elements that represent the most important knowledge and skills within the discipline.

As anyone who has been involved in a standards development effort knows, it is easier to add to standards than it is to limit what they cover. It is especially easier to resolve disagreements about the most important things to cover by including everything than it is to resolve the disagreements themselves. We are trying not to take the easier route. We have adopted the principle of parsimony and are trying to practice it. At the same time we are concerned not only to include those elements that represent the most important knowledge and skills within a subject area, but also to make those elements explicit. The approach we have adopted distinguishes between standards as a means of organizing the knowledge and skills of a subject area and as a reference point for assessment, and the program through which the work designed to enable students to achieve the standards is delivered.

For example, the conceptual understanding standards in Mathematics and Science are explicit about the concepts that students should understand at each grade level and in English Language Arts we have established a separate standard for conventions, grammar, and usage. This does not imply that conventions, grammar, and usage should be taught in isolation from other elements of English Language Arts. What it does imply is that the work students do should be designed to help them achieve the standard for conventions. It also implies that conventions should not only be among the things assessed but should also be a focus of explicit reporting of student achievement.

Standards should be manageable given the constraints of time.

This criterion follows very closely on the last one, but focuses particularly on making sure that standards are "doable." One of the features of this standards development effort is the level of interaction among the staff working on the different subject areas. We view the standards for the four areas as a set at each grade level; our publication of the standards by grade level reflects this orientation. This orientation allows us to avoid unnecessary overlaps and duplication across subject areas and to recognize and use opportunities for forging stronger connections among subject areas through the work that students do. A key to ensuring the standards are manageable is making the most of opportunities for student work to do double and even triple duty. These standards include several work samples that demonstrate the way a single project or task can generate student work relevant to more than one standard within a subject area and to standards in more than one subject area.

Standards should be adaptable, permitting flexibility in implementation needed for local control, state and regional variation, and differing individual interests and cultural traditions.

These standards are intended for use in widely differing settings. One approach to tackling the need for flexibility to accommodate local control, state and regional variation, and differing individual interests and cultural traditions, is to make the standards general and leave their translation into more specific statements for users at various levels. We have not adopted that approach. These standards need to be specific enough to guide the New Standards' assessment system; we have tried to make them specific enough to do so. We have also tried to achieve the necessary degree of specificity without unduly limiting the kinds of flexibility outlined above. As we have already mentioned, we are concerned to ensure that the work samples included to show the quality of work expected for meeting the standards come from the work of a diverse range of students. However, the specificity needed for standards intended to guide an assessment system does place limits on flexibility. To tackle these apparently contradictory demands on the standards, we have adopted the notion of "substitution." This means that when users of these standards identify elements in the standards that are inconsistent with decisions made at the local level, they can substitute their own. An example of this is the Reading standard in English Language Arts. The Reading standard states that students should read and comprehend, and specifies that they should read material of the quality and complexity illustrated in the sample reading list equivalent to twenty-five books each year. We have included the reading list so as to be clear about the quality of reading material we are talking about at each grade level. But we would not claim that this is the only reading list that would be appropriate. Thus, users who have established their own lists and are satisfied with them can replace the lists provided with their own. There is one important proviso, however. Substitution only works where what is added to the standards is comparable with the material it replaces in terms of both quality and quantity of expectation.

Standards should be clear and usable.

Making standards sufficiently clear so that parents, teachers, and students can understand what they mean and what the standards require of them is essential to the purpose for establishing standards in the first place. It is also a challenge because while all of these groups need to understand what the standards are, the kinds of information they need are different. The most obvious difference is between the way in which the standards need to be presented to elementary school students so that they know what they should be striving to achieve and the way in which those same standards need to be presented to teachers so that they can help their students get there. If the standards were written only in a form that elementary school students could access, we would have to leave out information teachers need to do their job.

These standards are being presented in several formats. This version of the standards is written primarily for teachers. It includes technical language about the subject matter of the standards and terms that educators use to describe differences in the quality of work students produce. It could be described as a technical document. That does not mean that parents and students should not have access to it, but it does mean that it includes language that may be difficult for students to comprehend and more detail than some parents may want to deal with.

Another version of the standards is in preparation. It is being written with parents and the community in general in mind. The standards will be the same but they will be explained in less technical language.

Standards should be reflective of broad consensus building, resulting from an iterative process of comment, feedback, and revision including educators and the general public.

This consultation draft is the result of revisions of earlier drafts on the basis of comment and feedback from reviewers nominated by the New Standards' partners and the New Standards' advisory committees for each of the subject areas, as well as other educators. Earlier drafts have also been the subject of review by focus groups of parents and other members of the general public.

This draft is being made available widely as the basis for review and comment through to the spring of 1996. A final version will be prepared for endorsement by the New Standards' Governing Board in June 1996.

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How Will the Performance Standards be Used?

The primary audience for these performance standards is teachers. We hope that teachers will use the standards to:

- help students and parents understand what work that meets standards looks like;
- inform discussions with their colleagues as they plan programs to help students learn to high standards;
- challenge assumptions about what we can expect from students;
- communicate the meaning of high standards to district administrators, school board members, and the public so they can work together to build learning environments that challenge all students.

New Standards will use the performance standards to provide:

- the basis of design specifications for the New Standards' assessment system;
- the basis for reporting student scores on assessments within the New Standards' system; and
- the basis for linking the New Standards' assessment system with the standards and assessment systems of the members of the New Standards' partnership.

Design specifications for the New Standards' assessment system

The New Standards' assessment system has two components: portfolios of work demonstrating performances produced by students over extended periods of time and with opportunities for revision; and examinations (known as reference examinations) completed under on-demand conditions.

The portfolio system has already been developed and trialed in English Language Arts and Mathematics, and reference examinations in those subjects have been developed and administered on a pilot basis. The performance standards will provide the basis of design specifications for the portfolio and examination systems in English Language Arts and Mathematics as these are progressively revised and refined. They will similarly provide the basis of design specifications for development of the assessment systems for Science and Applied Learning.

Student scores on assessments reported by standards

Student scores on assessments within the New Standards' system will be reported by standards; that is, student achievement will be reported in the form of a "profile" of scores, with each score reporting achievement in relation to one of the performance standards. Reporting students' scores in this way will provide richer and more comprehensive information about student achievement than can be provided by a single score.

Linking the New Standards' system with partners' standards and assessment systems

"Linking" is the process of establishing the extent and degree of match between the New Standards' system and those of the New Standards' partners. It is an essential step in the process of enabling partners to make decisions about their use of the New Standards' system, either in part or as a whole.

Linking is crucial for assuring that student work is assessed according to the same standards that guided its production.

The performance standards will provide the initial point of reference for the linking process. While comprehensive linking of assessment systems will require the further step of linking scores on performances, linking standards is a necessary first step and will provide a good indication of the potential for linking New Standards with partners' systems.

The linking process is underway with a small number of partners. This work has produced a protocol to guide the process. Linking will take place concurrently with the consultation and review phase of development of the performance standards. This will make it possible for the results of the linking process to inform review of the performance standards prior to their presentation to the New Standards' Governing Board for adoption in June 1996.

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How to Read These Standards

The standards for elementary school are set out in an overview on page 10. The overview provides only the names of the standards for each of the four areas: English Language Arts, Mathematics, Science, and Applied Learning. To help you keep the complete set of standards in your mind as you work through this volume we have included a bar listing all the standards for elementary school along the top of most pages.

Performance descriptions tell what students are expected to know and be able to do.

Turn to the performance descriptions for English Language Arts on page 12. Each standard has a performance description. The performance description is a narrative description of what students are expected to know and be able to do.

Elementary school level means the end of fourth grade.

The standards for elementary school are set at the level of achievement expected of students at about the end of fourth grade. Some students will achieve this level of performance earlier than the end of fourth grade. Some students will reach it later than the end of fourth grade.

Most standards are made up of several parts.

Most of the standards are made up of several parts, for example, the Reading standard has four parts.

The bold type shows what students should know and be able to do.

What is shown in bold type are the things students should know and be able to do.

Examples are the kinds of work students might do to demonstrate their achievement of the standards.

Immediately following the bold-typed description of the standard are examples of the kinds of work students might do to demonstrate their achievement. The examples also indicate the nature and complexity of activities that are appropriate to expect of students at the grade level. However, we chose the word "example" deliberately. The examples are intended only to show the kinds of work that students might do and to stimulate ideas for further kinds of work. None of the kinds of work shown in the examples is necessarily required to meet the standard.

Cross-references highlight examples of work that could meet the requirements of standards from two or more subject areas.

In a couple of instances, the examples that go with the English Language Arts performance descriptions include a cross-reference to one of the other subject areas. The cross-references highlight examples for which the same work, and possibly the same piece of work, may enable students to demonstrate their achievement of standards from more than one subject matter.

Most cross-references are to Applied Learning.

Most commonly the cross-reference is to Applied Learning. Applied Learning is not a subject area in its own right. It is expected that Applied Learning activities will generally take place within a subject such as English. The cross-references show work that may provide a vehicle for demonstrating standards within one or more subject areas as well as standards for Applied Learning.

Some cross-references also show the possibilities for using work from Mathematics or Science to demonstrate English Language Arts standards, and vice versa.

We have not tried to highlight every possible cross-reference, only to give an indication of the possibilities.

Margin notes draw attention to particular aspects of the standards.

The notes in the margin draw attention to particular aspects of the standards, such as the resources to which students need access in order to meet the requirements of the standards.

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Comparing the grade levels.

Each page showing performance descriptions has a note in the margin that directs attention to the Appendices which show the performance descriptions at each of the three grade levels: elementary, middle and high school.

Work samples and commentaries.

Next, turn to the work samples and commentaries that appear on the pages immediately following the performance descriptions.

Work samples illustrate "how good is good enough."

Each work sample is a genuine piece of student work. We have selected it because it illustrates the quality of work expected for one or more of the standards. In other words, it illustrates "how good is good enough."

(See "Not all standards are the same" below for more detail on how work samples illustrate standards.)

The commentary explains *why* the work illustrates how good is good enough.

The commentary that goes with each work sample is intended to help make sense of why the work shows how good is good enough. The commentary explains the task on which the student worked and the circumstances under which the work was completed, and draws attention to the qualities of the work with direct reference to the performance descriptions for the relevant standards.

The commentary also notes our reservations about the work.

The commentary also draws attention to any reservations we have about the student work.

In all cases, the work samples are genuine student work. While they provide valuable platforms from which to illustrate aspects of the standards, many samples are not "perfect" in every respect. Some, for example, include spelling errors, clumsy grammatical constructions, or errors of calculation. We think it is important that the standards be illustrated by means of authentic work samples and accordingly have made no attempt to doctor the work in order to correct these imperfections: the work has been included "warts and all". Where errors occur, we have included a note drawing attention to the nature of the mistakes and commenting on their significance in the context of the work. In some cases, for example, the work was produced as a first draft only (in which case it would be expected that the errors would be corrected in work presented as finished work), or produced by a student with limited English language proficiency, or there is evidence in the rest of the work to suggest that the error was a slip rather than an error in conceptual understanding.

In other words, we have tried to adopt reasonable expectations for correctness, but not to overlook errors where they arise. We have also resolved to apply those expectations consistently to all the work samples. We have paid attention to spelling, for example, not only in the work samples included to illustrate the English Language Arts standards, but also in those samples included to illustrate standards in the other subject areas. Similarly, we are also reviewing all work samples for accuracy in relation to mathematical and scientific content.

Performance Standards = performance descriptions + work samples + commentaries on the work samples.

Performance standards are therefore made up of a combination of performance descriptions, work samples, and commentaries on the work samples:

The performance descriptions tell what students should know and be able to do.

The work samples show what work that is judged good enough looks like.

The commentaries explain why the work is good enough with reference to the performance description.

A work sample may illustrate more than one standard.

Often the work samples illustrate the quality of work expected for more than one standard. For example, some of the work samples selected to illustrate parts of the Writing standard also illustrate expectations for the Conventions standard, or for the Literature standard, or possibly even both.

"Enchiladas" (see page 18) is an example of a work sample that illustrates more than one standard in English Language Arts.

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How to Read These Standards

A single work sample may illustrate standards from more than one subject area.

Similarly, a single work sample may illustrate standards drawn from more than one subject area. For example, a project completed for Mathematics Standard 8, Putting Mathematics to Work, may also illustrate the report writing part of English Language Arts Standard 2, Writing. It may also qualify as a project within the requirements of Applied Learning Standard 1, Problem Solving.

"Canned Food Drive" (see page 80) is an example of a work sample that illustrates standards from more than one subject area.

Standards are highlighted in the bar at the top of the page.

The bar along the top of the pages showing student work highlights the standards that are illustrated by each work sample.

World class connections provide a basis for comparison.

On most pages showing work samples and commentaries we have included an example of a standard, a portion of the curriculum, or a student activity drawn from material collected from other countries. These examples provide a basis for comparison with the performance standards. The full list of references from which these examples are drawn is shown on pages 112-113.

Not all standards are the same.

As you read these standards it will become apparent that the standards are not all the same. The most obvious difference is the way in which the performance descriptions are written. We have not imposed a single style on the ways in which the standards are written, because the various standards have different purposes that lend themselves to different kinds of presentation. Nevertheless, there are some patterns. We have identified three categories or kinds of standards, distinguished by their relationship to products of student learning and by the range of evidence required to demonstrate achievement of the standards. The distinctions are broad rather than neat, and we have sought only to define them generally rather than precisely.

The differences among the standards have consequences for what it means to meet a standard and, therefore, for the ways in which we can use samples of student work to illustrate what work that is good enough looks like.

Standards that describe a piece of work.

One kind of standard is characterized by the Writing standard in English Language Arts. Each part of this standard literally describes a piece of work that students are expected to produce, and the knowledge and skills that should be evident in that work. For this standard there is a one to one relationship between each part of the standard and a piece of work.

Standards that fit this category generally are:
English Language Arts Standards 1, 2, and 5;
Mathematics Standard 8;
Science Standard 8;
Applied Learning Standards 1, 2, and 5.

In the case of Mathematics Standard 8, Putting Mathematics to Work, Science Standard 8, Scientific Investigation, and Applied Learning Standard 1, Problem Solving, there is a one to one relationship between the standard as a whole and a piece of work.

Standards of this kind have several features:

- A single piece of work can meet the standard. In fact all of the requirements of the standard usually must be evident in a single piece of work for it to be judged as meeting the standard.
- The qualities that must be evident in a piece of work for it to meet the standard can be stated explicitly and are listed in bullet points as part of the bold-typed performance description. These qualities can be thought of as assessment criteria or as a rubric for work that meets the standard.

Commentaries make judgments about the whole piece of work.

Commentaries on work samples that illustrate these standards make judgments about the whole piece of work.

See, for example, "Dream House Project" on page 52.

Standards that focus exclusively on conceptual understanding.

A second kind of standard is characterized by Mathematics Standard 1, Arithmetic and Number Concepts. This standard focuses exclusively on conceptual understanding.

Standards that fit this category generally are:
Mathematics Standards 1, 2, 3, and 4;
Science Standards 1, 2, 3, and 4.

These standards have several features:

- The standard comprises a number of distinct parts. It is most unlikely that any single piece of work will demonstrate all parts of the standard. In fact, it is common for a single piece of work to relate only to some aspects of one part of the standard. Thus, the standard can usually only be met by multiple pieces of work.

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- Conceptual understanding is developmental. Any one piece of work may contain elements of conceptual understanding that are below what is expected for the grade level and elements that either meet or exceed what is expected for the grade level. Judging whether the work is "up to standard" often means making an on-balance judgment. The developmental nature of conceptual understanding makes it difficult to specify in more than general terms the qualities that need to be pre sent in a piece of work for it to be judged as being up to standard for the grade level. These expectations are being defined concept by concept.

Commentaries are qualified by comments about further evidence needed.

Commentaries on work samples that illustrate these standards are qualified by comments about further evidence needed to demonstrate meeting the standard.

See, for example, "Sandbox" on page 64 and "Flinkers" on page 67.

Standards that describe skills and tools.

The third kind of standard is characterized by English Language Arts Standard 3, Conventions, Grammar, and Usage of the English Language. It is made up of the standards that describe skills and tools, such as analytical skills.

Standards that fit this category generally are:
English Language Arts Standards 3 and 4;
Mathematics Standards 5, 6, and 7;
Science Standards 5, 6, and 7;
Applied Learning Standards 3 and 4.

What distinguishes these standards from the other kinds is the body of evidence needed to demonstrate that the standard has been met. In some cases it is possible that a single piece of work could provide evidence of all of the features required to meet the standard; this is so for the standard for Conventions, Grammar, and Usage of the English Language, for example. But it would be rare for a single piece of work to constitute sufficient evidence for meeting the standard. Here, sufficiency refers not only to the idea of coverage but also to a notion of consistency of application. We want to be confident that the work in question is representative of a body of work.

Ideally, work that provides evidence for these standards also provides evidence for other standards.

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Commentaries are qualified by comments about further evidence needed.

Commentaries on work samples that illustrate these standards are qualified by comments about further evidence needed to demonstrate meeting the standard.

See, for example, "How Many Handshakes?" on page 48.

The collection of work samples is not complete.

In no case is the current collection of work samples adequate for the purpose of illustrating the performance standards.

Nor is the current collection of work samples yet adequate for the purpose of displaying a sufficient range of the ways in which students might produce work that illustrates the standards. We are making a deliberate effort to ensure that the overall collection of work samples is drawn from a diverse range of students. Given the role of the work samples in helping to articulate the meaning of the standards, it is critical that their content reflects the diversity of the cultures and experiences of the students for whom the standards are intended.

It is possible that, as the collection of work samples proceeds, some of the work samples currently included will be discarded in favor of others.

Some standards cannot be illustrated by written work samples.

Some standards are not illustrated here because they cannot be illustrated by written work samples. Obvious examples of these standards are English Language Arts Standard 3, Speaking, Listening, and Viewing and the oral presentation parts of Applied Learning Standard 2, Communication Tools and Techniques.

We are in the process of collecting samples of performances on videotape and will produce a videotape to complement this book containing work samples and commentaries focusing on oral work and other performances.

Overview of the Performance Standards

English Language Arts

1. Reading
2. Writing
3. Speaking, Listening, and Viewing
4. Conventions, Grammar, and Usage of the English Language
5. Literature

Mathematics

1. Arithmetic and Number Concepts
2. Geometry and Measurement Concepts
3. Function and Algebra Concepts
4. Statistics and Probability Concepts
5. Problem Solving and Mathematical Reasoning
6. Mathematical Skills and Tools
7. Mathematical Communication
8. Putting Mathematics to Work

Science

1. Physical Sciences Concepts
2. Life Sciences Concepts
3. Earth and Space Sciences Concepts
4. Scientific Connections and Applications
5. Scientific Thinking
6. Scientific Tools and Technologies
7. Scientific Communication
8. Scientific Investigation

Applied Learning

1. Problem Solving
2. Communication Tools and Techniques
3. Information Technology Tools and Techniques
4. Learning and Self-management Tools and Techniques
5. Tools and Techniques for Working With Others

The elementary school standards are set at a level of performance approximately equivalent to the end of fourth grade. It is expected that some students might achieve this level earlier and others later than this grade.

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PERFORMANCE DESCRIPTIONS, WORK SAMPLES & COMMENTARIES

English Language Arts

Mathematics

Science

Applied Learning

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To see how these performance descriptions compare with the expectations for middle school and high school, turn to pages 84-89.

The reading requirement assumes an adequate library of appropriate reading material. In some places, library resources are too meager to support the amount of reading required for every student to achieve this standard. Where a shortage of books exists, better use of out-of-school resources must be made; for example, students may have to be assured access to local or county libraries.

Reading twenty-five books a year entails a substantial amount of time. Students may use materials read in conjunction with their regular class work, including courses other than English, to satisfy this requirement.

Reading "in depth" is intended to encourage students to invest themselves thoroughly in an area that interests them. Such an investment will generate reading from an array of resources, giving students more experience of reading as well as increased understanding of a subject. It is not intended to be some cursory experience of doing research on a topic which often requires little more than scanning materials, copying directly from references, and inserting transitional phrases and paragraphs. The challenge with the depth requirement is to encourage instead a complex understanding developed and enhanced through reading.

The "response to literature" in the Writing standard is meant to replace the more typical literary analysis paper that many students routinely produce in conjunction with literature study. This does not preclude literary analysis but instead opens up possibilities for reader response as well.

1. Reading

Reading is a process which includes demonstrating comprehension; analyzing and interpreting printed texts; making connections between parts of a text, among several texts, and between texts and other experiences in and out of school; making extensions and applications of a text; and evaluating texts. (Note that "comprehension" means basic understanding, i.e., getting the gist of a text.)

The student reads and comprehends material of the quality and complexity illustrated in the sample reading list equivalent to twenty-five books each year. The materials should include traditional and contemporary children's literature or the equivalent in children's magazines, newspapers, textbooks, and media, from at least three different literary forms and from at least five different writers. The student produces evidence of reading that:

- **demonstrates a thorough understanding of the text as a whole;**
- **identifies complexities presented in the text, i.e., ideas, information, levels of meaning;**
- **extracts salient information from the text;**
- **uses paraphrasing judiciously.**

Examples of producing evidence of reading include:

- maintaining annotated lists of works read;
- generating reading logs or journals;
- participating in formal and informal book talks.

The student reads in depth at least four books (or book equivalents) about one issue or subject, or four books by a single writer, or four books in one genre, and produces evidence of reading that:

- **makes and supports warranted and responsible assertions about the texts;**
- **supports assertions with elaborated and convincing evidence;**
- **makes perceptive and well developed connections;**
- **evaluates writing strategies and elements of the author's craft.**

Examples of producing evidence of reading in depth include:

- constructing book reviews;
- producing literary response papers;
- producing research reports;
- participating in formal and informal book talks.

The student reads informational materials to develop understanding and expertise and produces written or oral work that:

- **restates or summarizes information;**
- **relates new information to prior knowledge and experience;**
- **extends ideas;**
- **makes connections to related topics or information.**

Examples of producing evidence of reading informational materials include:

- comparing and contrasting information with specific prior knowledge, and personal experience;
- connecting information to known pieces of literature, media, or local and world events;
- drawing inferences or conclusions;
- differentiating between fact and opinion;
- analyzing and interpreting features of texts;
- evaluating texts.

The student reads aloud, accurately (in the range of 85-90%), familiar material of the quality and complexity illustrated in the sample reading list, and in a way that makes meaning clear to listeners by:

- **self correcting when subsequent reading indicates an earlier miscue;**
- **using a range of cueing systems, e.g., phonics and context clues, to determine pronunciation and meanings;**
- **reading with a rhythm, flow, and meter that sounds like everyday speech.**

SAMPLE READING LIST

Sample reading list from which students and teachers could select. This list is not exclusive. Acceptable titles also appear on lists produced by organizations such as the National Council of Teachers of English and the American Library Association. Substitutions might also be made from lists approved locally.

Fiction

Brink, *Caddie Woodlawn;*
Cleary, *Ramona and Her Father;*
Coerr, *The Josefina Story Quilt;*
Cohen, *Fat Jack;*
De Saint-Exupery, *The Little Prince;*
Hamilton, *Zeely;*
Hansen, *The Gift-Giver;*
Lord, *In the Year of the Boar and Jackie Robinson;*
Mendez and Byard, *The Black Snowman;*
Naidoo, *Journey to JoBurg;*
O'Dell, *Zia;*
Ringgold, *Tar Beach;*
Speare, *The Sign of the Beaver;*
Yep, *Child of the Owl.*

Non-Fiction

Aliki, *Corn Is Maize: The Gift of the Indians;*
Baylor, *The Way to Start a Day;*
Cherry, *The Great Kapok Tree;*
Epstein, *History of Women in Science for Young People;*
Greenfield, *Childtimes: A Three-Generation Memoir;*
Godkin, *Wolf Island;*
Hamilton, *Anthony Burns: The Defeat and Triumph of a Fugitive Slave;*
McKissack, *Frederick Douglass: The Black Lion;*
Politi, *Song of the Swallows;*
Sattler, *Dinosaurs of North America;*
Fritz, *And Then What Happened, Paul Revere?;*
McGovern, *The Secret Soldier: The Story of Deborah Sampson.*

Poetry

Ahlberg, *Heard It in the Playground;*
Blishen and Wildsmith, *Oxford Book of Poetry for Children;*
De Regniers, Moore, White, and Carr, eds., *Sing a Song of Popcorn;*
Giovanni, *Ego-Tripping and Other Poems for Young People;*
Greenfield, *Honey, I Love and Other Love Poems;*
Heard, *For the Good of the Earth and Sun;*
Janeczko, *Strings: A Gathering of Family Poems;*
Koch and Farrell, eds., *Talking to the Sun;*
Lobel, ed., *The Random House Book of Mother Goose;*
Manguel, ed., *Seasons;*
Mathis, *Red Dog, Blue Fly: Football Poems;*
Silverstein, *Where the Sidewalk Ends.*

Folklore

Griego y Maestas, *Cuentos: Tales From the Hispanic Southwest;*
French, *Snow White in New York;*
Huck and Lobel, *Princess Furball;*
Louie and Young, *Yeh-Shen: A Cinderella Story From China;*
Luenn, *The Dragon Kite;*
Goble, *Buffalo Woman;*
Steptoe, *Mufaro's Beautiful Daughters;*
Steptoe, *The Story of Jumping Mouse;*
Kipling, *The Elephant's Child;*
Lee, *Legend of the Milky Way.*

Modern Fantasy and Science Fiction

Andersen, *The Ugly Duckling;*
Bond, *A Bear Called Paddington;*
Dahl, *James and the Giant Peach;*
Grahame, *The Wind in the Willows;*
Lewis, *The Lion, The Witch and The Wardrobe;*
Norton, *The Borrowers;*
Van Allsburg, *Jumanji;*
White, *Charlotte's Web.*

Children's magazines

Weekly Reader;
Creative Classroom;
Social Studies for the Young Learner;
World (National Geographic);
News (Scholastic);
Action (Scholastic);
Local newspapers or their equivalents.

Other

Manuals appropriate for elementary school children, e.g., Nintendo, other computer manuals.

2. Writing

Writing is a process through which a writer shapes language to communicate effectively in terms of purposes, audiences, and contexts.

The student produces four types of writing.

A report, in which the writer:

- **engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;**
- **develops a controlling idea that conveys a perspective on the subject;**
- **creates an organizing structure appropriate to a specific purpose, audience, and context;**
- **includes appropriate facts and details;**
- **excludes extraneous and inappropriate information;**
- **uses a range of appropriate strategies, such as providing facts and details, describing or analyzing the subject, and narrating a relevant anecdote.**

Examples of reports include:

- an informative report;
- an attribute book;
- a chapter book.

A response to literature, in which the writer:

- **engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;**
- **advances a judgment that is interpretive, analytic, evaluative, or reflective;**
- **supports a judgment through references to the text, references to other works, authors, or non-print media, or references to personal knowledge;**
- **demonstrates understanding of the literary work.**

Examples of responses to literature include:

- a literary response paper;
- a book review;
- a parody;
- a literary analysis paper.

A narrative account (fictional or autobiographical), in which the writer:

- **engages the reader by establishing a context, creating a point of view, and otherwise developing reader interest;**
- **establishes a situation, plot, point of view, setting, and conflict (and for autobiography, the significance of events);**
- **creates an organizing structure;**
- **includes sensory details and concrete language to develop plot and character;**
- **excludes extraneous details and inconsistencies;**
- **develops complex characters;**
- **uses a range of appropriate strategies, such as dialogue and tension or suspense.**

(Writing Performance Description continued on next page.)

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3. Speaking, Listening, and Viewing

(continued)

Examples of narrative accounts include:
- ▲ an autobiographical account;
- ▲ an imaginative story.

A narrative procedure, in which the writer:
- **engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;**
- **provides a guide to action that anticipates a reader's needs, creates expectations through predictable structures, e.g., headings, and provides transitions between steps;**
- **makes use of appropriate writing strategies such as creating a visual hierarchy and using white space and graphics as appropriate;**
- **includes relevant information;**
- **excludes extraneous information;**
- **anticipates problems, mistakes, and misunderstandings that might arise for the reader.**

Examples of narrative procedures include:
- ▲ a set of rules for organizing a class meeting;
- ▲ a chapter book developed around procedures, e.g., how to have a safe vacation, with chapters on safe swimming, safe games, and other issues of safety;
- ▲ a how-to report to accompany a game;
- ▲ a set of procedures for checking out library books *(see also Applied Learning Standard 1)*.

The student accesses and exchanges information; that is, the student:
- **asks appropriate questions;**
- **responds to the questions of others;**
- **paraphrases and summarizes to increase understanding;**
- **listens responsively to others' points of view;**
- **uses language which is simple and appropriate for communicating;**
- **speaks audibly;**
- **makes appropriate eye contact;**
- **respects turn taking of other speakers;**
- **uses language and gestures expressively and persuasively;**
- **shows awareness of an audience by adjusting to its reaction.**

Examples of accessing and exchanging information include:
- ▲ initiating a conversation with the teacher to clarify understanding of an assignment or activity;
- ▲ responding with relevant and informative answers when asked about topics, important ideas, or recent events;
- ▲ interviewing community members about local history or neighborhood projects *(see also Applied Learning Standard 1)*;
- ▲ contributing equitably to, and acknowledging contributions from others in, a group inquiry project *(see also Applied Learning Standard 5)*;
- ▲ proposing and defending a plan for a group action project *(see also Applied Learning Standard 2)*;
- ▲ making an oral presentation *(see also Mathematics Standard 7; Science Standard 7; Applied Learning Standard 2)*.

The student responds to oral presentations; that is, the student:
- **asks appropriate questions;**
- **paraphrases and summarizes to increase understanding;**
- **speaks audibly;**
- **uses language and gestures expressively and persuasively;**

Examples of responding to oral presentations include:
- ▲ responding appropriately to stories and poems read aloud;
- ▲ making logical connections between a presentation and related ideas and works;
- ▲ participating in role playing activities which extend a story ending or elaborate on a historical event.

The student makes informed judgments about television, radio, and film productions; that is, the student:
- **articulates reasoned judgments for selecting particular television and radio productions and rejecting others;**
- **recounts the story elements of television, radio, and film productions;**
- **identifies the intended messages of advertisements, entertainment programs, and news programs.**

Examples of making informed judgments about television, radio, and film productions include:
- ▲ presenting a coherent retelling of a television show episode;
- ▲ creating a television or radio commercial for an imaginary product;
- ▲ preparing a news bulletin relative to a school event *(see also Applied Learning Standard 1)*;
- ▲ identifying the turning point in the action of a film.

4. Conventions, Grammar, and Usage of the English Language

The student regularly uses, with some teacher assistance, appropriate conventions of the English language, including:
- **spelling;**
- **sentence construction;**
- **paragraph structure;**
- **punctuation;**
- **grammar;**
- **usage.**

Examples of using appropriate conventions include:
- ▲ demonstrating in a piece of writing the ability to manage the conventions, grammar, and usage of English so that they aid rather than interfere with reading;
- ▲ proofreading acceptably the student's own writing or the writing of others, using dictionaries and other resources, including the teacher or peers as appropriate;
- ▲ observing conventions of language during formal oral presentations.

The student analyzes and revises written work, as appropriate, relative to audiences and purposes by:
- **adding or deleting details;**
- **adding or deleting explanations;**
- **clarifying difficult passages;**
- **rearranging words, sentences, and paragraphs to improve or clarify meaning;**
- **sharpening the focus;**
- **reconsidering the organizational structure.**

Examples of analyzing and revising written work include:
- ▲ considering and responding to the critiques of peers and teachers;
- ▲ critiquing the writing of a peer.

5. Literature

The student responds to fiction, non-fiction, poetry, and drama using interpretive, critical, and evaluative processes; that is, the student does one or more of the following in oral or written presentations:
- **examines the reasons for a character's actions, taking into account the situation and basic motivation of the character;**
- **identifies recurring themes across works;**
- **identifies stereotypical characters as opposed to fully developed characters;**
- **critiques the degree to which a plot is contrived or realistic;**
- **makes inferences and draws conclusions about context, events, characters, and setting;**
- **analyzes the impact of authors' decisions regarding word choice and content;**
- **considers the function of point of view or persona;**
- **considers the differences among genres;**
- **evaluates literary merit.**

Examples of responding to literature include:
- ▲ determining why certain characters (either fictional or non-fictional) behave the way they do;
- ▲ making connections between literary works according to a common theme;
- ▲ producing a creative retelling of a familiar fairy tale to a group of adults;
- ▲ creating a verse by verse paraphrase of a poem;
- ▲ comparing a children's literary classic with a televised version of the same work.

The student writes works in specific genres that incorporate appropriate literary features.

Examples of writing works in specific literary genres include:
- ▲ writing poetry, e.g., free verse and rhymed;
- ▲ writing and/or producing a short play;
- ▲ creating a picture book;
- ▲ writing a story *(see also Applied Learning Standard 1)*.

Samples of student work that help explain "how good is good enough" for these standards can be found immediately following these pages.

It is not intended that all student work developed to meet the English Language Arts standards should necessarily come from an English class. The challenge is to ensure that Mathematics, Science, and Applied Learning work samples are incorporated widely into the English Language Arts work samples, thus encouraging students to use work from other classes while not weakening the English curriculum.

These standards allow for oral performances of student work whenever appropriate.

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Work Sample & Commentary: *How to Tap Dance*

1 Reading	**2 Writing**	3 Speaking, Listening & Viewing	**4 Conventions, Grammar & Usage**	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

English Language Arts required by the task

Students were given the task of writing an "I Know How to..." paper.

Circumstances of performance

	timed assignment
	extended project
✓	opportunity for revision
	first draft
✓	revised draft
	teacher generated topic
✓	student generated topic
✓	embedded in class work
	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:

Standard 2, Writing—produces a narrative procedure; **Standard 4, Conventions, Grammar, and Usage of the English Language**—uses appropriate conventions.

Writing

The student produces a narrative procedure, in which the writer:

- **engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;**
- **provides a guide to action that anticipates a reader's needs, creates expectations through predictable structures, e.g., headings, and provides transitions between steps;**
- **makes use of appropriate writing strategies such as creating a visual hierarchy and using white space and graphics as appropriate;**
- **includes relevant information;**
- **excludes extraneous information;**
- **anticipates problems, mistakes, and misunderstandings that might arise for the reader.**

This work provides evidence that the student:

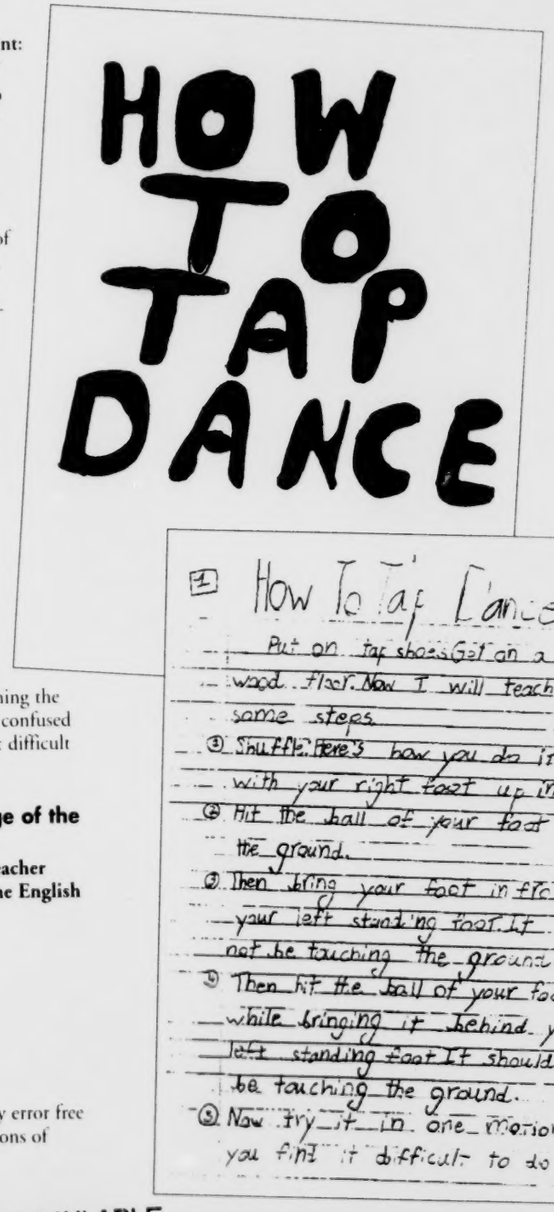
- establishes a context for the main idea of the piece through a simple title, "How to Tap Dance," and through use of imperatives in the opening: "Put on tap shoes"; "Get on a hard wood floor" [p. 1];
- incorporates a series of progressions into the piece at several different levels: first, each individual step requires the details of that step to be carefully laid out; second, the steps themselves become more complex, with the last step specifically identified as the most difficult: "This is considered an advanced tap step" [p. 4];
- identifies the transitional points, both within a particular step, e.g., "Start...Hit...Then...Now..." [p. 1]; and between steps, e.g., "Here is a step that you could put after a shuffle or a flap" [p. 2];
- uses embedded headings, e.g., "Shuffle:...Flap:..." [pp. 1-2];
- includes enough information so that the piece becomes more than just a tutorial but not so much that it impedes the instructional content;
- shows a sense of audience by anticipating the points at which a reader learning the dance steps might become frustrated or confused and provides solutions: "If you find that difficult then start back at step 1" [p. 2].

Conventions, Grammar, and Usage of the English Language

The student regularly uses, with some teacher assistance, appropriate conventions of the English language, including:

- **spelling;**
- **sentence construction;**
- **paragraph structure;**
- **punctuation;**
- **grammar;**
- **usage.**

The sample demonstrates through virtually error free writing the ability to manage the conventions of spelling and usage.


HOW TO TAP DANCE
1 How To Tap Dance
Put on tap shoes. Get on a hard wood floor. Now I will teach you some steps.
③ Shuffle: Here's how you do it. Start with your right foot up in back
② Hit the ball of your foot on the ground.
③ Then bring your foot in front of your left standing foot. It should not be touching the ground.
④ Then hit the ball of your foot while bringing it behind your left standing foot. It should not be touching the ground.
⑤ Now try it in one motion. If you find it difficult to do this,
then start back at step 1 and try it again. Here is another step that you might find easier.
Flap: Here's how you do it.
① Pick your foot up off the ground and hit the ball of your foot on the ground right where you picked it up.
② Then pick up the same foot and hit the ball of your foot right in front of you. If you find that difficult then start back at step 1. Flap: Here is a step that you could put after a shuffle or a flap.
Ballchange: Here's how you do it.

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3

① take one of your feet and step behind the other foot.
② When the foot that stepped hits the ground, lift your other off the ground.
③ Then last but not least, step with the foot that's in the air. If you don't understand this step, start back from step one of ballchange. Here is a step that you might find fun called boogie woogie. Here is how you do it.
① Stand with your feet flat on the ground.
② Lift your right heel off the ground.
③ Then drop your right heel and

4

pat your left heel up the arms to this step are.
① Stick your index fingers out and put your hands by your sides.
② When your right heel goes down put your right hand down. You should still have your index fingers sticking out.
③ When your left heel goes down your left hand goes down. Here is one of the more difficult steps that I know.
21 Tap riff. Here's how you do it. I'll count the sounds. Pick up your right foot.
sound① Hit the ball of your right foot.

5

sound② Then hit your right heel.
sound③ The drop your left standing heel.
sound④ Brush your right heel back crossing over your standing leg.
sound⑤ Brush back on your right ball of the foot.
sound⑥ Drop standing left heel again. Then repeat these six sounds again wrapping your foot the other way. 12 sounds in all. Now for 13, 14, and 15 you repeat the first three sounds I told you making a total of 15 sounds so far.

6

sound⑯ Place the right heel down.
sound⑰ Drop the right toe down. For 18, 19, 20, and 21 drop the back left heel, then front right heel, back left heel, front right heel. The total is 21 sounds. Then use your left foot to reverse the 21 tap riff. This is considered an advanced tap step. That is the last step I can teach you. Bye.

Japanese young people are expected "to write passages after making one's ideas clear or putting them in order, to write in such a way as to make the central point of what is to be written clear, and to speak in such a way as to make the central point of the content easily understandable."

Course of Study for Elementary Schools in Japan, p. 14.

Happy Feet

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Work Sample & Commentary: *CYO Basketball*

1 Reading	2 **Writing**	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

English Language Arts required by the task

Students were asked to write expressively for a short period of time and then to write for another purpose using the same topic. The first piece was completed in class; the second, as a homework assignment.

Circumstances of performance

	timed assignment
	extended project
	opportunity for revision
✓	first draft
	revised draft
	teacher generated topic
✓	student generated topic
	embedded in class work
	research required

This work sample provides evidence for the quality of work expected for the following part of the English Language Arts writing standards:

Standard 2, Writing—produces a narrative account; produces a report.

Writing

The student produces a narrative account (fictional or autobiographical), in which the writer:

- **engages the reader by establishing a context, creating a point of view, and otherwise developing reader interest;**
- **establishes a situation, plot, point of view, setting, and conflict (and for autobiography, the significance of events);**
- **creates an organizing structure;**
- **includes sensory details and concrete language to develop plot and character;**
- **excludes extraneous details and inconsistencies;**
- **develops complex characters;**
- **uses a range of appropriate strategies, such as dialogue and tension or suspense.**

The "Expressive" piece provides evidence that the student:

- creates a persona of a basketball player replaying a moment in the heat of the game: "Palms sweating, throat getting dry…Elbowed in the stomach, punched in the nose…"; and providing a nice closure to a brief but effective piece by foreshadowing a possible future event: "When I get the letter…";
- identifies the significance of the action on the basketball court: shows how the experience might lead to "the letter saying I made the 'A' team";
- uses precise, concrete language and sensory details, e.g., "Palms sweating, throat getting dry…Elbowed in the stomach, punched in the nose…";
- is brief and to the point, avoiding extraneous details and inconsistencies;
- uses tension effectively by delaying the results of the lay-up until after a tongue-in-cheek rhetorical question: "Is my NBA career over?"

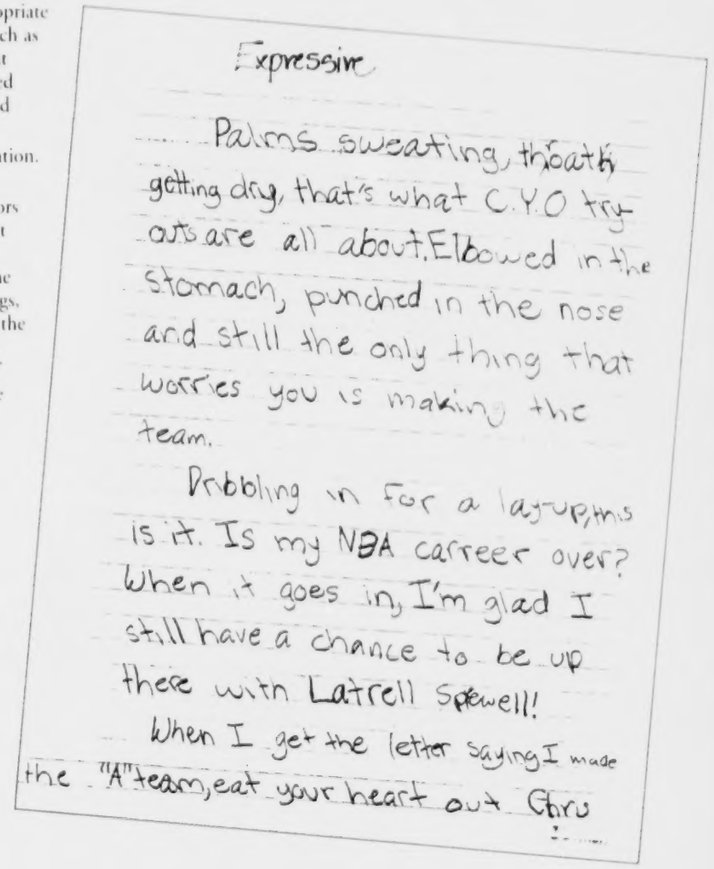
The student produces a report, in which the writer:

- **engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;**
- **develops a controlling idea that conveys a perspective on the subject;**
- **creates an organizing structure appropriate to a specific purpose, audience, and context;**
- **includes appropriate facts and details;**
- **excludes extraneous and inappropriate information;**
- **uses a range of appropriate strategies, such as providing facts and details, describing or analyzing the subject, and narrating a relevant anecdote.**

The "Informative" piece provides evidence that the student:

- establishes an informative context by presenting important pieces of information about the organization of the CYO basketball league, e.g., "The league is from 4th grade to 6th"; and by providing a reason for supplying the information: "The 2 tryouts are on…";
- uses an organizational strategy that arranges the information in two ways: first, from broad to narrow: from "C.Y.O. is a basketball league…" to "if you didn't make the team…"; second, according to a sequence of events: "You have to try out…" and "A week later, each person will receive a letter…";
- includes facts and details appropriate for a fourth grade audience, such as grade level requirements, tryout dates and times, qualities looked for in successful candidates, and notification procedures;
- excludes inappropriate information.

The spelling and grammatical errors in this work sample do not detract from the work but would not be acceptable in polished writing. The writer is aware of some misspellings, e.g., the correction of "thoath" in the first line of the "Expressive" piece and the check mark over "atitude" in the final line of page one of the "Informative" piece.



Expressive

Palms sweating, throath getting dry, that's what C.Y.O try outs are all about. Elbowed in the stomach, punched in the nose and still the only thing that worries you is making the team.

Dribbling in for a lay-up, this is it. Is my NBA carreer over? When it goes in, I'm glad I still have a chance to be up there with Latrell Sprewell!

When I get the letter saying I made the "A" team, eat your heart out Chris

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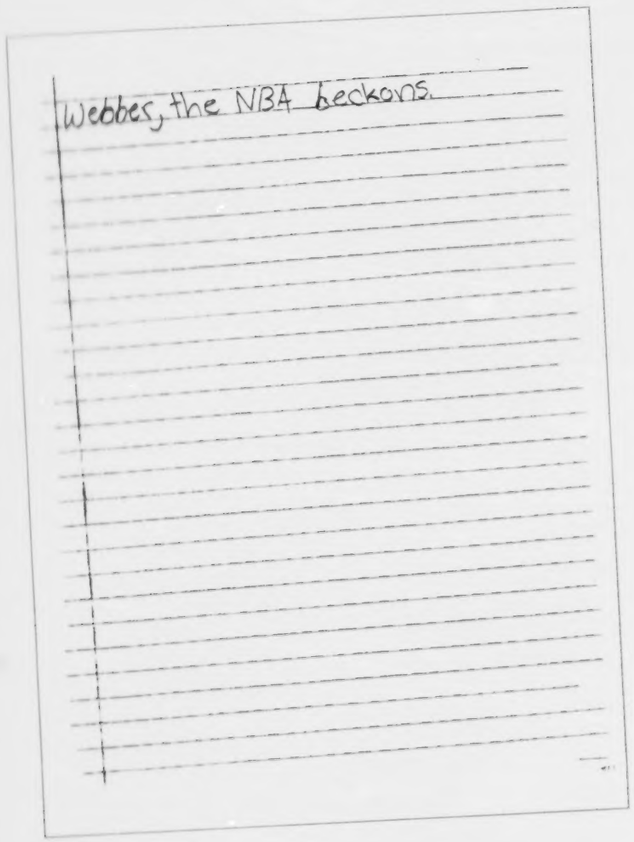
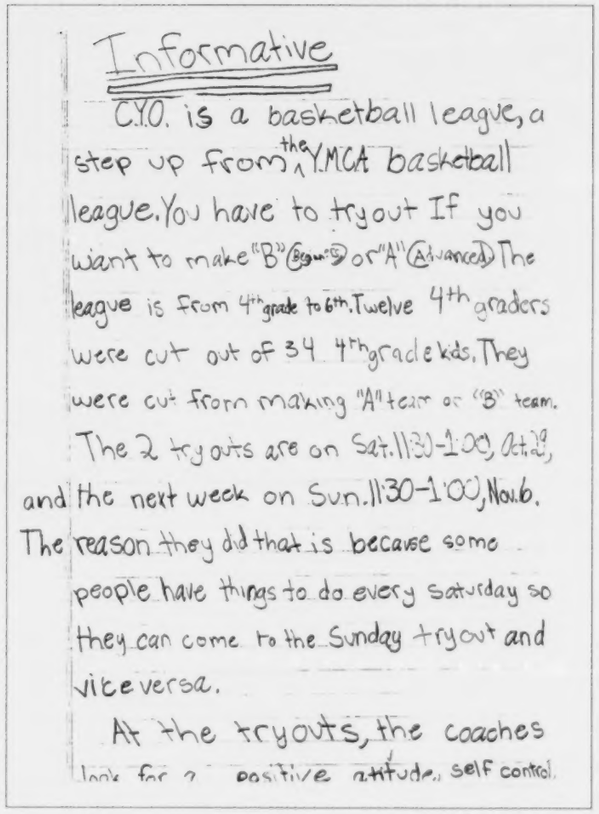


Webbes, the NBA beckons.

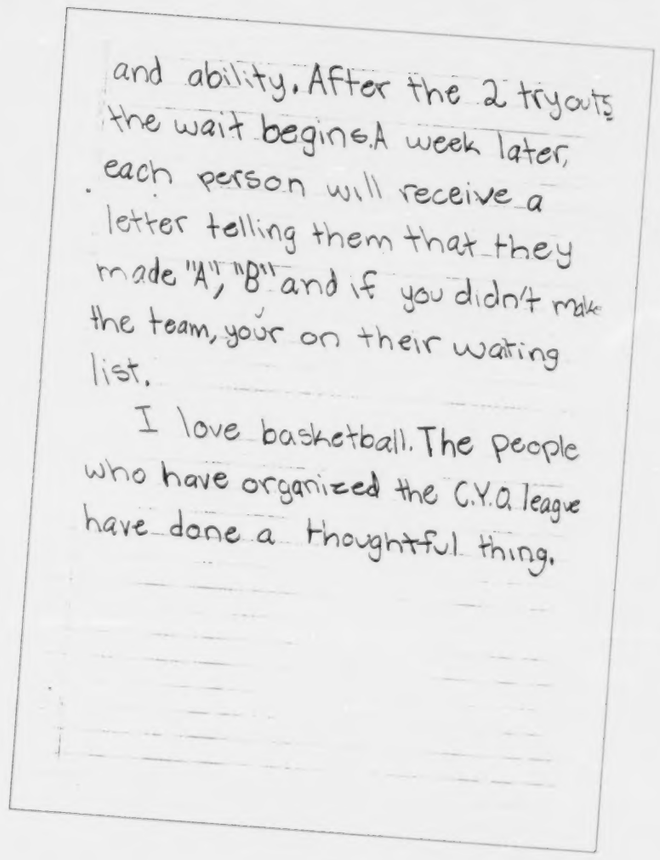


Informative

C.Y.O. is a basketball league, a step up from the Y.M.C.A basketball league. You have to tryout If you want to make "B" (Beginners) or "A" (Advanced) The league is from 4th grade to 6th. Twelve 4th graders were cut out of 34 4th grade kids. They were cut from making "A" team or "B" team.

The 2 tryouts are on Sat. 11:30-1:00, Oct. 29, and the next week on Sun. 11:30-1:00, Nov. 6. The reason they did that is because some people have things to do every saturday so they can come to the Sunday tryout and vice versa.

At the tryouts, the coaches look for a positive attitude, self control



and ability. After the 2 tryouts the wait begins. A week later, each person will receive a letter telling them that they made "A", "B" and if you didn't make the team, your on their waiting list.

I love basketball. The people who have organized the C.Y.O. league have done a thoughtful thing.

In Norway, "the pupils should learn to write to different recipients (teachers, other pupils, other people) so that they can practise expressing themselves in a way that well be understood. In all classes, and at their own level of ability, the pupil shall learn to choose a way and style of writing to suit the message, the situation, and the recipient. Throughout all grades the pupils must be allowed to write about issues that interest them, and to argue for their own opinion."

Curriculum Guidelines for Compulsory Education in Norway, p. 150

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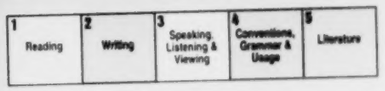
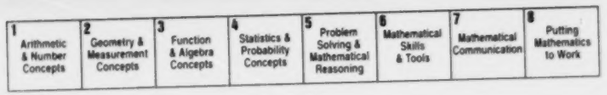
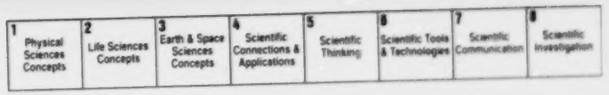
Work Sample & Commentary: *Enchiladas*



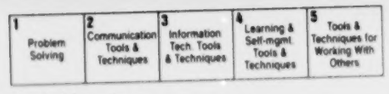
English Language Arts


1 Arithmetic & Number Concepts
2 Geometry & Measurement Concepts
3 Function & Algebra Concepts
4 Statistics & Probability Concepts
5 Problem Solving & Mathematical Reasoning
6 Mathematical Skills & Tools
7 Mathematical Communication
8 Putting Mathematics to Work

Mathematics


1 Physical Sciences Concepts
2 Life Sciences Concepts
3 Earth & Space Sciences Concepts
4 Scientific Connections & Applications
5 Scientific Thinking
6 Scientific Tools & Technologies
7 Scientific Communication
8 Scientific Investigation

Science


1 Problem Solving
2 Communication Tools & Techniques
3 Information Tech. Tools & Techniques
4 Learning & Self-mgmt. Tools & Techniques
5 Tools & Techniques for Working With Others

Applied Learning

An extended project, here, is one that has occurred over a sustained period of time, generally at least one week, and often longer.

English Language Arts required by the task

Students were asked to select a topic to which they had a commitment in their lives and then choose a genre in which to express the commitment. Students were required to revise and edit their writing before "publishing" the complete texts. The work shown here is one recipe and an anecdote from a much longer project involving a whole series of recipes and anecdotes compiled into a book titled "La Mesa Esta Puesta (The Table Is Set)." This student also produced the work in Spanish.

Circumstances of performance

	timed assignment
✓	extended project
✓	opportunity for revision
	first draft
✓	revised draft
	teacher generated topic
✓	student generated topic
✓	embedded in class work
✓	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:

Standard 2, Writing—produces a narrative procedure; produces a narrative account;

Standard 4, Conventions, Grammar, and Usage of the English Language—uses appropriate conventions;

Standard 5, Literature—writes works in specific genres.

Writing

The student produces a narrative procedure, in which the writer:

- **engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;**
- **provides a guide to action that anticipates a reader's needs, creates expectations through predictable structures, e.g., headings, and provides transitions between steps;**
- **makes use of appropriate writing strategies such as creating a visual hierarchy and using white space and graphics as appropriate;**
- **includes relevant information;**
- **excludes extraneous information;**
- **anticipates problems, mistakes, and misunderstandings that might arise for the reader.**

The recipe section of this work provides evidence that the student:

- engages the reader, by using the title of the larger project, "La Mesa Esta Puesta (The Table Is Set)," and a colorful cover (not shown) to identify the project as a Spanish/English recipe book, and by including both the recipes and the accompanying anecdotes which serve to identify a broader context for each recipe beyond just the production of a food item;
- works within an established genre with which the audience would be familiar (a recipe);
- uses appropriate writing strategies: identifies the logical steps involved in cooking: "To begin…You then fry the tortillas… You then fill them up…"; uses an example to clarify a procedure: "roll them like a taco";
- includes relevant information; note: the sample does not specify that the oil in the ingredients list is used to "fry the tortillas a bit," but the oversight is minor and would not interfere with the procedure;
- excludes extraneous information.

The student produces a narrative account (fictional or autobiographical), in which the writer:

- **engages the reader by establishing a context, creating a point of view, and otherwise developing reader interest;**
- **establishes a situation, plot, point of view, setting, and conflict (and for autobiography, the significance of events);**
- **creates an organizing structure;**
- **includes sensory details and concrete language to develop plot and character;**
- **excludes extraneous details and inconsistencies;**
- **develops complex characters;**
- **uses a range of appropriate strategies, such as dialogue and tension or suspense.**

The anecdote section of this work provides evidence that the student:

- develops reader interest: uses the recipe as an effective precursor to the anecdote, shedding a unique light on both the recipe and the anecdote; observes the story-telling genre in the anecdote, thus making it more appealing, by beginning "The day" rather than "One day";
- identifies the conflict in the story as the burning of the enchiladas but with a positive—and therefore somewhat ironic—result: "Now, we can eat them all ourselves";
- includes appropriate details through the descriptions involving tastes and smells: "the smell of the chile cooking" that "creeps out the windows" becomes a potent image that works using very simple language;
- uses several appropriate narrative strategies for telling a story, including characterization, e.g., "Mariquita" who enters the room "chatting…as always" and "The other two comadres 'the religious ones'" who "forgot about church"; and uses a plot sequence that includes all the appropriate elements—rising action: arrival of the various guests who serve as distracters; conflict: conversation instead of cooking; climax: burning the enchiladas; conclusion: the guests excusing themselves.

Conventions, Grammar, and Usage of the English Language

The student regularly uses, with some teacher assistance, appropriate conventions of the English language, including:

- **spelling;**
- **sentence construction;**
- **paragraph structure;**
- **punctuation;**
- **grammar;**
- **usage.**

This work provides evidence that the student:

- demonstrates through almost error free writing the ability to manage the conventions of spelling and usage;
- manages a variety of sentence constructions.

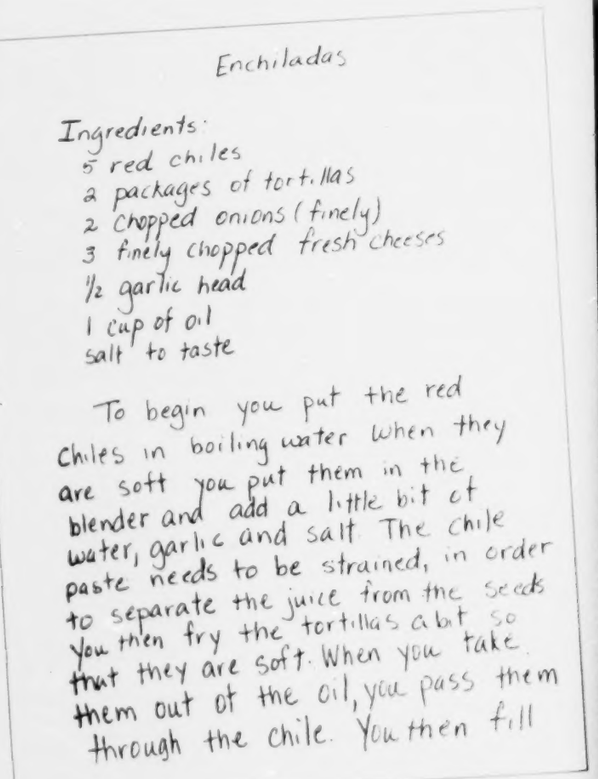
The few mistakes in this work sample are more likely "slips" than actual errors, e.g., whereas no apostrophe is used in the line "one of my moms…" the same construction is later used properly.

Literature

The student writes works in specific genres that incorporate appropriate literary features.

This work, which is an excerpt from a memoir picture book, provides evidence that the student:

- replicates the format of the picture book, including text and pictures;
- uses illustrations that help carry the story along.



Enchiladas

Ingredients:
5 red chiles
2 packages of tortillas
2 chopped onions (finely)
3 finely chopped fresh cheeses
½ garlic head
1 cup of oil
salt to taste

To begin you put the red chiles in boiling water when they are soft you put them in the blender and add a little bit of water, garlic and salt. The chile paste needs to be strained, in order to separate the juice from the seeds. You then fry the tortillas a bit so that they are soft. When you take them out of the oil, you pass them through the chile. You then fill

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In New Zealand, achievement objectives for transactional writing at the elementary level include asking students to "write instructions and explanations, state facts and opinions, and recount events in a range of authentic contexts."

English in the New Zealand Curriculum, p. 92.

them up with cheese and onions and roll them like a taco.

The day my mother made enchiladas all the neighbors came to visit us. They say that it is because the smell of the chile cooking creeps out the windows. Tona, one of my moms comadres came in with her baby crying. Maria, well "Mariquita" to the ones that knew her came in chatting away, as always. The other two comadres "the religious ones" forgot about church and walked in with their Bibles. On this occasion my mom started talking as she cooked. All the ladies were sitting in the kitchen around the table. My mom got into the talking so much that she forgot the enchiladas, so they burned. But, my mom still served them like that. When the ladies tasted them they looked at each other and started getting up excusing themselves. From that day on, no one ever came back for my mom's enchiladas. Now, we can eat them all ourselves.

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Work Sample & Commentary: *The Stained Glass Tree*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	Statistics & Probability Concepts	Problem Solving & Mathematical Reasoning	Mathematical Skills & Tools	Mathematical Communication	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

An extended project, here, is one that has occurred over a sustained period of time, generally at least one week, and often longer.

English Language Arts required by the task

Students were required to take an entry from their writer's notebook and develop it into a picture book. This student chose two entries describing her grandmother's house. After reciting them as a story in a small response group, she wrote the rough draft that eventually developed into the picture book.

Circumstances of performance

	timed assignment
✓	extended project
✓	opportunity for revision
	first draft
✓	revised draft
	teacher generated topic
✓	student generated topic
✓	embedded in class work
	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:

Standard 2, Writing—produces a narrative procedure;

Standard 4, Conventions, Grammar, and Usage of the English Language—uses appropriate conventions.

Standard 5, Literature—writes works in specific genres.

Writing

The student produces a narrative account (fictional or autobiographical), in which the writer:

- **engages the reader by establishing a context, creating a point of view, and otherwise developing reader interest;**
- **establishes a situation, plot, point of view, setting, and conflict (and for autobiography, the significance of events);**
- **creates an organizing structure;**
- **includes sensory details and concrete language to develop plot and character;**
- **excludes extraneous details and inconsistencies;**
- **develops complex characters;**
- **uses a range of appropriate strategies, such as dialogue and tension or suspense.**

This work provides evidence that the student:

- develops reader interest by establishing a unique point of view: the sample walks the reader through a house, gives a description of the house detailed enough to communicate the personality of the owner, which allows the reader to draw conclusions regarding the grandmother's personality;
- establishes a situation that is simply a tour through her grandmother's house;
- establishes a logical organizing structure by using the tour.

Conventions, Grammar, and Usage of the English Language

The student regularly uses, with some teacher assistance, appropriate conventions of the English language, including:

- **spelling;**
- **sentence construction;**
- **paragraph structure;**
- **punctuation;**
- **grammar;**
- **usage.**

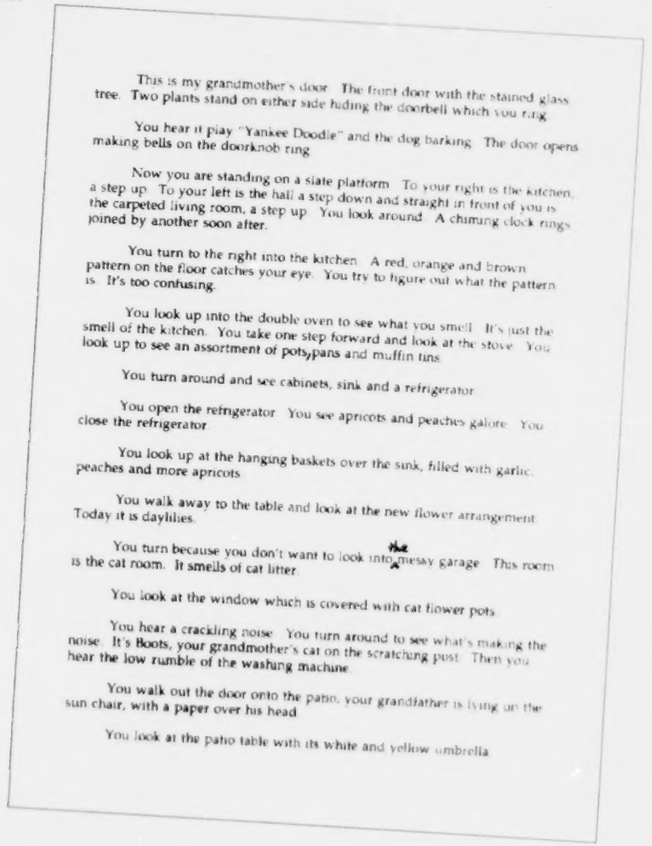
The sample demonstrates through virtually error free writing the ability to manage the conventions of the English language.

Literature

The student writes works in specific genres that incorporate appropriate literary features.

This work provides evidence that the student:

- uses a full color format consistent with picture books produced by professional writers and publishers;
- establishes a clear context for each page that is supported by both the drawings and the text;
- tells an effective story by narrating the process of moving through the grandmother's home;
- makes sensory details visual in the pictures accompanying the text, e.g., a picture of the entire cabinet, viewed from afar, and a picture of a single large tea cup, viewed up close, accompany the line "You look at all the tea cups for at least five minutes";
- uses poetic imagery in a way appropriate to both the tone and the setting of the piece, e.g., "You look out the window one last time at the lighted seaside which now looks like a Fourth of July fireworks show that has been paused";
- uses a title that orients the reader and creates a focal point; in the end, the piece returns to the focal point, reorienting a reader who has been behind the stained glass tree rather than merely in front of it.



This is my grandmother's door. The front door with the stained glass tree. Two plants stand on either side hiding the doorbell which you ring.

You hear it play "Yankee Doodle" and the dog barking. The door opens making bells on the doorknob ring.

Now you are standing on a slate platform. To your right is the kitchen, a step up. To your left is the hall a step down and straight in front of you is the carpeted living room, a step up. You look around. A chiming clock rings joined by another soon after.

You turn to the right into the kitchen. A red, orange and brown pattern on the floor catches your eye. You try to figure out what the pattern is. It's too confusing.

You look up into the double oven to see what you smell. It's just the smell of the kitchen. You take one step forward and look at the stove. You look up to see an assortment of pots,pans and muffin tins.

You turn around and see cabinets, sink and a refrigerator.

You open the refrigerator. You see apricots and peaches galore. You close the refrigerator.

You look up at the hanging baskets over the sink, filled with garlic, peaches and more apricots.

You walk away to the table and look at the new flower arrangement. Today it is daylilies.

You turn because you don't want to look into the messy garage. This room is the cat room. It smells of cat litter.

You look at the window which is covered with cat flower pots.

You hear a crackling noise. You turn around to see what's making the noise. It's Boots, your grandmother's cat on the scratching post. Then you hear the low rumble of the washing machine.

You walk out the door onto the patio, your grandfather is lying on the sun chair, with a paper over his head.

You look at the patio table with its white and yellow umbrella.

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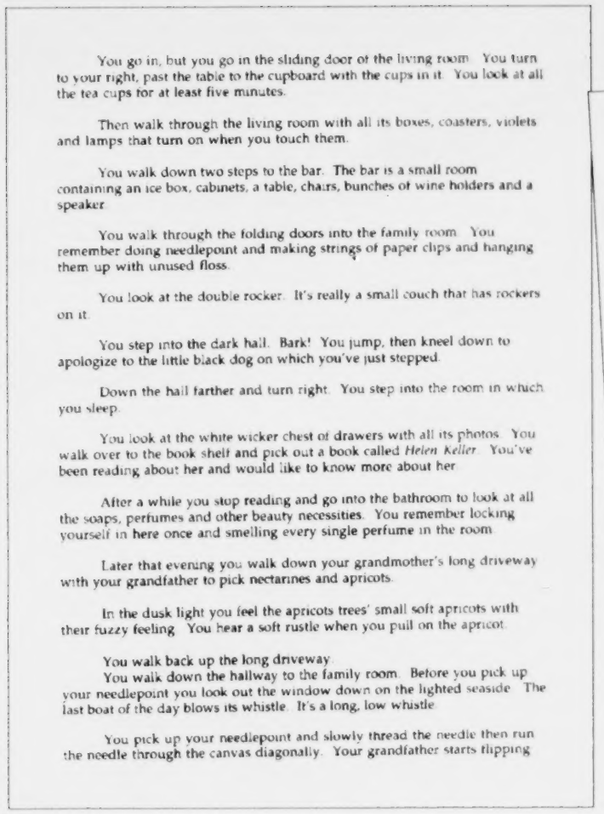


You go in, but you go in the sliding door of the living room. You turn to your right, past the table to the cupboard with the cups in it. You look at all the tea cups for at least five minutes.

Then walk through the living room with all its boxes, coasters, violets and lamps that turn on when you touch them.

You walk down two steps to the bar. The bar is a small room containing an ice box, cabinets, a table, chairs, bunches of wine holders and a speaker.

You walk through the folding doors into the family room. You remember doing needlepoint and making strings of paper clips and hanging them up with unused floss.

You look at the double rocker. It's really a small couch that has rockers on it.

You step into the dark hall. Bark! You jump, then kneel down to apologize to the little black dog on which you've just stepped.

Down the hall farther and turn right. You step into the room in which you sleep.

You look at the white wicker chest of drawers with all its photos. You walk over to the book shelf and pick out a book called *Helen Keller*. You've been reading about her and would like to know more about her.

After a while you stop reading and go into the bathroom to look at all the soaps, perfumes and other beauty necessities. You remember locking yourself in here once and smelling every single perfume in the room.

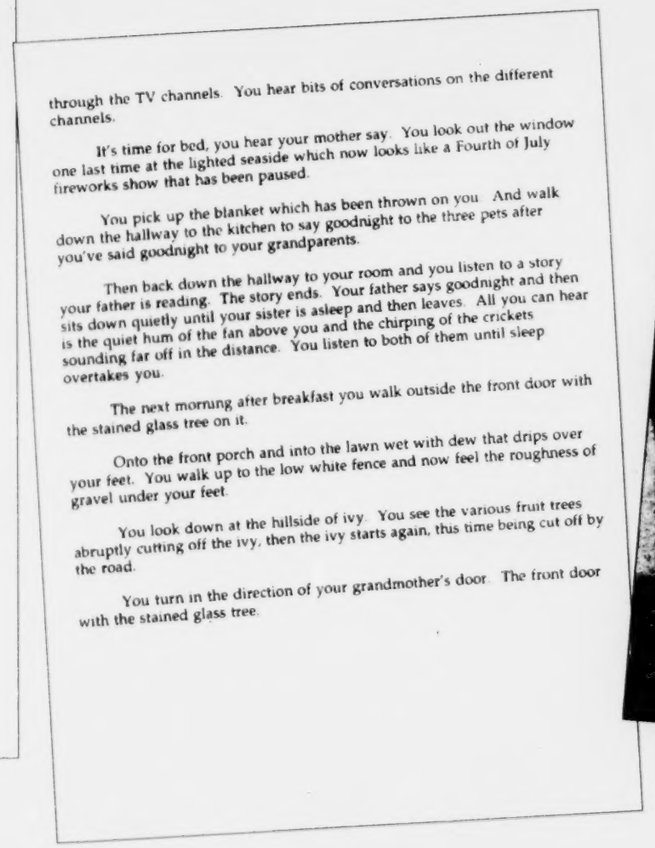
Later that evening you walk down your grandmother's long driveway with your grandfather to pick nectarines and apricots.

In the dusk light you feel the apricots trees' small soft apricots with their fuzzy feeling. You hear a soft rustle when you pull on the apricot.

You walk back up the long driveway.

You walk down the hallway to the family room. Before you pick up your needlepoint you look out the window down on the lighted seaside. The last boat of the day blows its whistle. It's a long, low whistle.

You pick up your needlepoint and slowly thread the needle then run the needle through the canvas diagonally. Your grandfather starts flipping



through the TV channels. You hear bits of conversations on the different channels.

It's time for bed, you hear your mother say. You look out the window one last time at the lighted seaside which now looks like a Fourth of July fireworks show that has been paused.

You pick up the blanket which has been thrown on you. And walk down the hallway to the kitchen to say goodnight to the three pets after you've said goodnight to your grandparents.

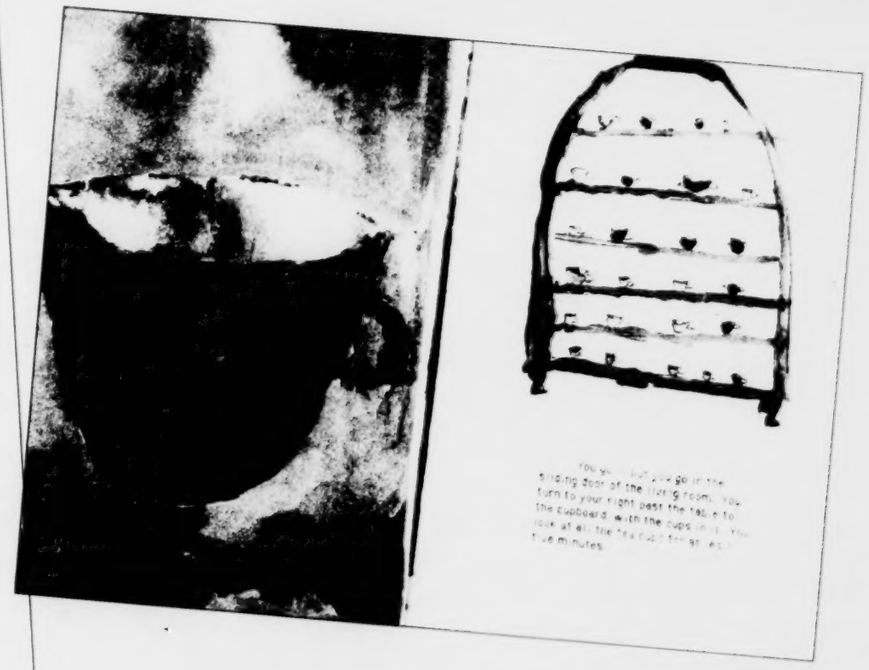
Then back down the hallway to your room and you listen to a story your father is reading. The story ends. Your father says goodnight and then sits down quietly until your sister is asleep and then leaves. All you can hear is the quiet hum of the fan above you and the chirping of the crickets sounding far off in the distance. You listen to both of them until sleep overtakes you.

The next morning after breakfast you walk outside the front door with the stained glass tree on it.

Onto the front porch and into the lawn wet with dew that drips over your feet. You walk up to the low white fence and now feel the roughness of gravel under your feet.

You look down at the hillside of ivy. You see the various fruit trees abruptly cutting off the ivy, then the ivy starts again, this time being cut off by the road.

You turn in the direction of your grandmother's door. The front door with the stained glass tree.



Norwegian elementary school children are expected to "produce texts themselves, give rein to their imagination, describe experiences and express opinions through stories, fairy tales, poems, letters, diaries, etc."

Curriculum Guidelines for Compulsory Education in Norway, p. 151.

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Work Sample & Commentary: *A Rainbow of Your Own*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

An extended project, here, is one that has occurred over a sustained period of time, generally at least one week, and often longer.

The quality of the writing in this work sample owes much to the fact that the student had the opportunity to revise the work. The final document emerged from many revisions, each of which led progressively to the high quality of the final draft.

English Language Arts required by the task

Students were asked to write a persuasive essay on a topic of their own choosing.

Circumstances of performance

	timed assignment
✓	extended project
✓	opportunity for revision
	first draft
✓	revised draft
	teacher generated topic
✓	student generated topic
	embedded in class work
	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:

Standard 4, Conventions, Grammar, and Usage of the English Language—analyzes and revises written work;

Standard 5, Literature—writes works in specific genres.

Conventions, Grammar, and Usage of the English Language

The student analyzes and revises written work, as appropriate, relative to audiences and purposes by:

- **adding or deleting details;**
- **or deleting explanations;**
- **clarifying difficult passages;**
- **rearranging words, sentences, and paragraphs to improve or clarify meaning;**
- **sharpening the focus;**
- **reconsidering the organizational structure.**

This work provides evidence that the student:

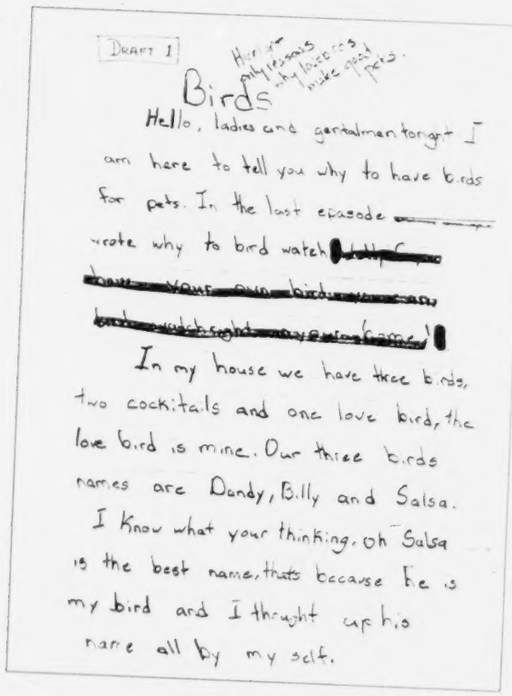
- rethinks the piece through multiple versions, e.g., the first draft includes information and anecdotes about various birds and finds four reasons why birds make good pets—this information appears in different forms in subsequent drafts;
- adds details and rethinks prior ideas through the drafts, e.g., in an early draft, fifteen reasons and arguments are listed and numbered according to the sequence in which they might subsequently be used;
- lists in the margins possible counter arguments to the list of "reasons/arguments" developed between drafts and indicates the need for an introduction (spelled "Intordotion");
- demonstrates an ability to see a body of information from a variety of perspectives, e.g., in the second draft, the title has changed from "Birds" to "Love Birds," and the piece has taken the form of a speech;
- listens and responds to critiques from teachers/adults, e.g., the list of fifteen reasons to have a pet lovebird was created as the result of a suggestion by an adult to "highlight only reasons why lovebirds make good pets"; listens and responds to critiques from peers, e.g., the speech version was critiqued by other students as lacking in organization and subsequently redrafted into the final version with the focus on reorganizing the arguments;
- develops drafts of both an introduction and a conclusion;
- progresses from a jumbled set of facts through a disorganized speech to a polished, well-organized report, suggesting an understanding of the writing process and the ability to make substantive changes as appropriate.

Literature

The student writes works in specific genres that incorporate appropriate literary features.

This persuasive essay provides evidence that the student:

- develops reader interest with an appealing title, "A Rainbow of Your Own," and with an intriguing first sentence: "Have you ever seen a rainbow with two beady, black eyes?";
- informs the reader of the persuasive nature of the piece: "A lovebird would be the perfect pet for you";
- makes the most persuasive appeal by speaking directly to the reader: "I'm sure that some of you like to bird watch, right?"; details the reasons that lovebirds make perfect pets, e.g., "they come when you call…don't eat as much as dogs or cats…are just the right size to hold and enjoy" and "His feathers are like fluffy clouds";
- anticipates the concerns of a pet owner and provides an impressive list of arguments, e.g., agrees in paragraph three that talking birds may be too loud but points out that there are compensating factors: "their noises are either talking or nice singing" and "can be very enjoyable";
- supports arguments with detailed evidence, citing personal experience: lovebirds "are also very funny. For instance, my bird, Salsa, makes funny faces and is always ready for another hilarious battle with one of his toys";
- arranges reasons, examples, and anecdotes persuasively, e.g., in paragraph four, the argument begins with the hardiness of lovebirds, moves on to a comparison of the feeding needs of lovebirds and other pets, to paper training, to size, and finally to the ease of having lovebirds cared for while the owner is away;
- excludes information and arguments that are irrelevant.



DRAFT 1

Birds

Hello, ladies and gentalman tonight I am here to tell you why to have birds for pets. In the last episode I wrote why to bird watch [illegible]

In my house we have three birds, two cockitails and one love bird, the love bird is mine. Our three birds names are Dandy, Billy and Salsa. I know what your thinking, oh Salsa is the best name, thats because he is my bird and I thought up his name all by my self.

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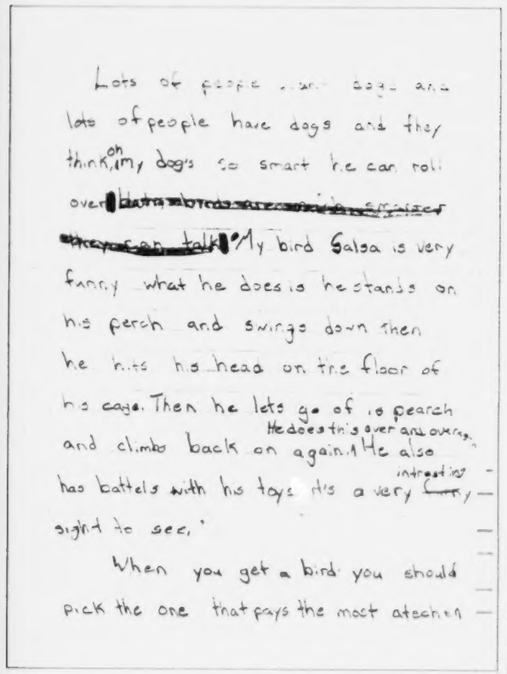
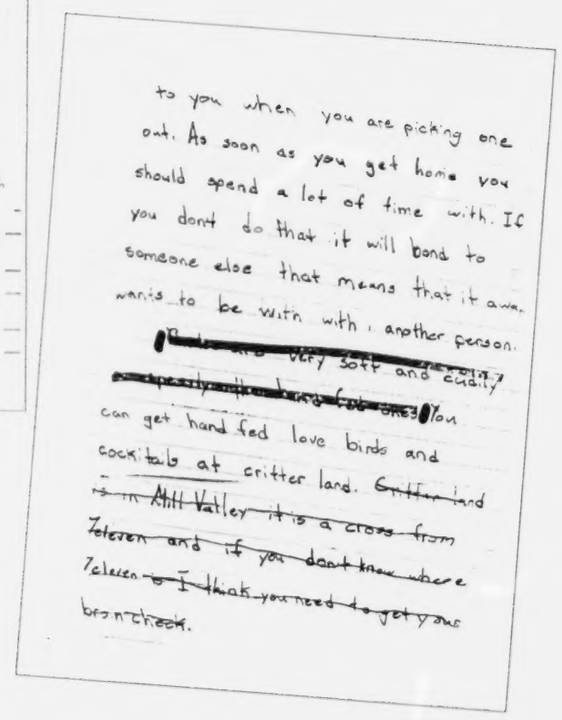
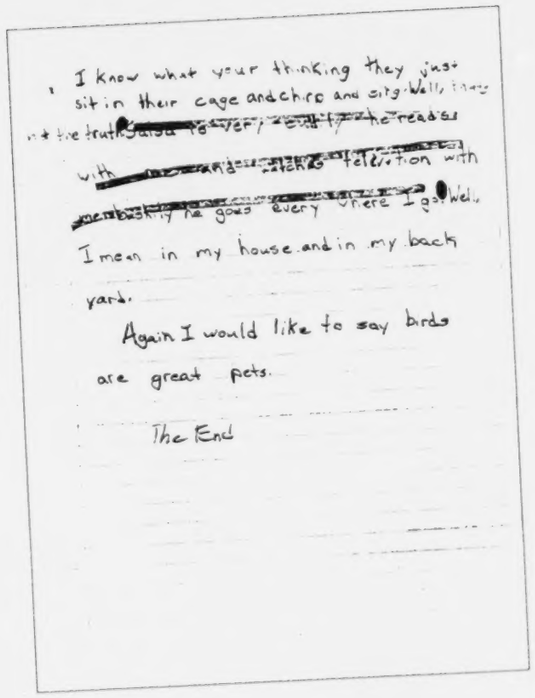


Lots of people have dogs and lots of people have dogs and they think, oh my dogs so smart he can roll over [illegible] they can talk. My bird Salsa is very funny what he does is he stands on his perch and swings down then he hits his head on the floor of his cage. Then he lets go of the perch and climbs back on again. He does this over and over. He also has battels with his toys it's a very interesting sight to see.

When you get a bird you should pick the one that pays the most attention



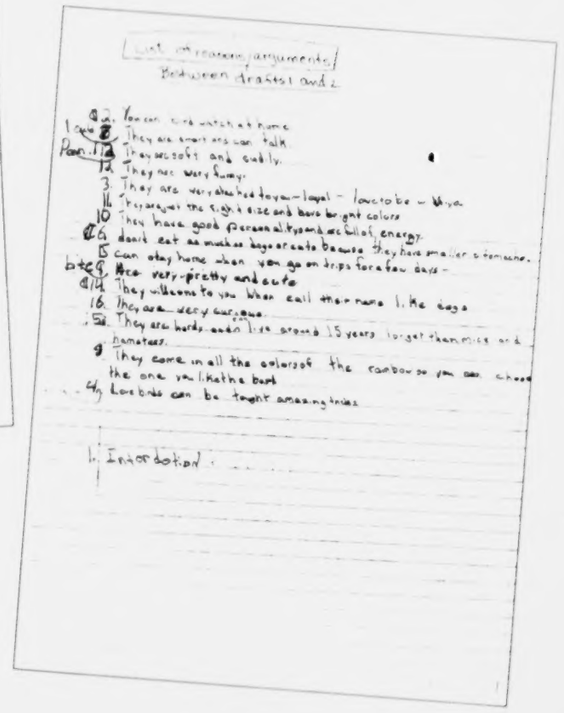
to you when you are picking one out. As soon as you get home you should spend a lot of time with. If you dont do that it will bond to someone else that means that it wants to be with with another person. [illegible] very soft and cuddly. [illegible] You can get hand fed love birds and cockatails at critter land. [illegible] Valley it is a cross from 7eleven and if you dont know where 7eleven is I think you need to get your brain check.



I know what your thinking they just sit in their cage and chirp and sing. Well, that's not the truth because he is very [illegible] he reads with [illegible] watches television with me basicly he goes every where I go. Well, I mean in my house and in my back yard.

Again I would like to say birds are great pets.

The End



List of reasons/arguments/
Between traits 1 and 2

1. You can watch at home
2. They are smart so can talk
3. They are soft and cuddly
4. They are very funny
5. They are very attached to you - loyal - love to be with you
6. They are not the right size and have bright colors
7. They have good personalities and are full of energy
8. don't eat as much as dogs or cats because they have smaller stomachs
9. Can stay home when you go on trips for a few days -
10. Are very pretty and cute
11. They will come to you when call their name like dogs
12. They are very curious
13. They are hardy and live around 15 years longer than mice and hamsters.
14. They come in all the colors of the rainbow so you can choose the one you like the best
15. Love birds can be taught amazing tricks

1. Introduction

French students are expected to "practice written composition (outline, articulation of ideas, organise into paragraphs) in different genres, especially narrative; translate from the spoken to the written word, and conversely; paraphrase texts; reconsider, correct and re-write their earlier work."

Les cycles à l'école primaire, p. 102.

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Work Sample & Commentary: *A Rainbow of Your Own* continued

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

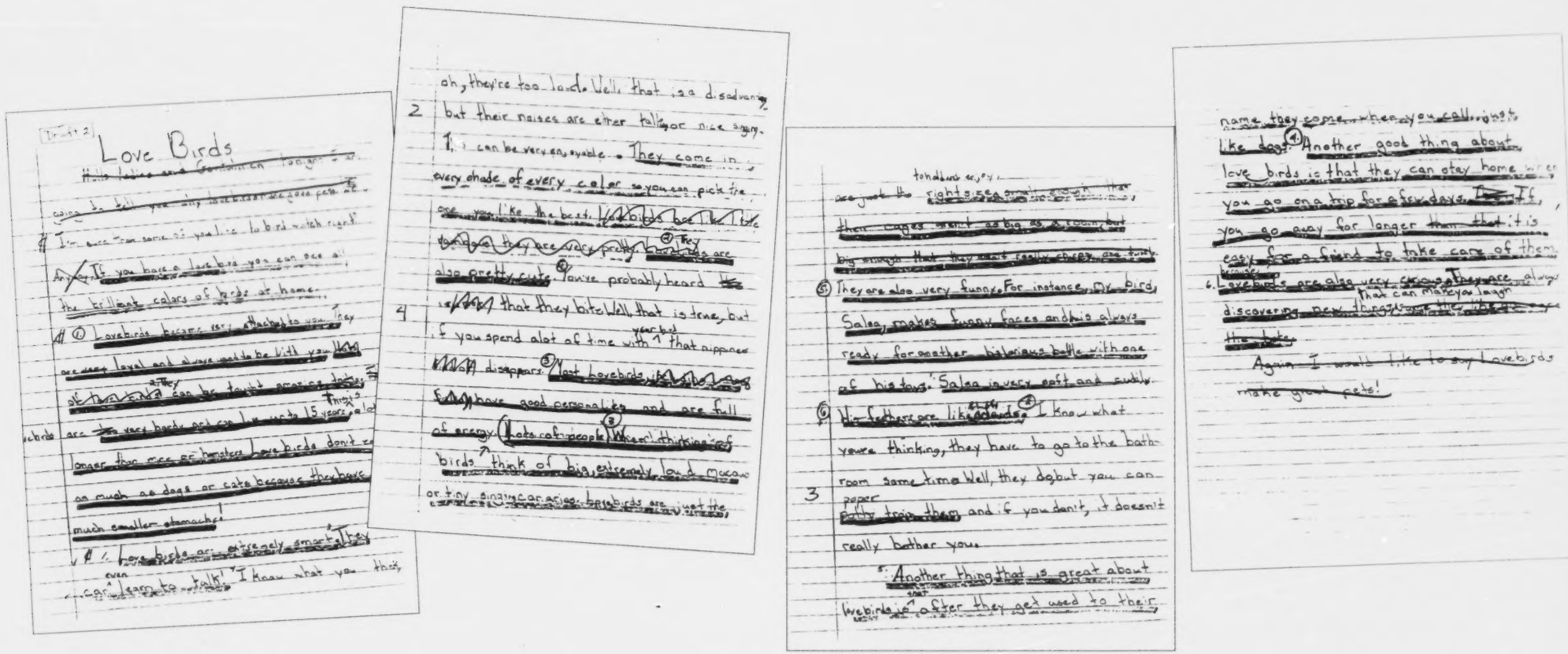
Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning



Draft 2

Love Birds

Have leaves and feathers too.

Have big beaks

I'm sure from some of you like to bird watch right?

If you have a lovebird you can see all the brilliant colors of birds at home.

① Lovebirds because they attached to you. They are very loyal and always want to be with you. They also can be taught amazing things are the very hardy pet can be up to 15 years old longer than mice or hamsters love birds don't as much as dogs or cats because they have much smaller stomaches.

② Love birds are already smart. They even can learn to talk! I know what you think,

oh, they're too loud. Well, that is a disadvantage but their noises are either talking or nice singing.

③ can be very enjoyable. They come in every shade of every color so you can pick the one you like the best. Lovebirds look like little

④ They are very pretty birds are also pretty cute. You've probably heard that they bite! Well, that is true, but if you spend alot of time with your bird that appears disappears. ⑤ Most lovebirds

have good personalities and are full of energy. Lots of people don't think of birds

birds. think of big, extremely loud macaw or tiny singing canaries. Lovebirds are just the

today enjoy

use just the right size

then cages aren't as big as a room, but big enough that they won't really chew, are truly

⑤ They are also very funny. For instance, my bird, Salsa, makes funny faces and is always ready for another hilarious battle with one of his toys. Salsa is very soft and cuddly.

⑥ His feathers are like velvet. I know what you're thinking, they have to go to the bathroom same time. Well, they do but you can

paper

potty train them and if you don't, it doesn't really bother you.

⑦ Another thing that is great about lovebirds is after they get used to their

name they come when you call right to

Like dogs. Another good thing about

love birds is that they can stay home when

you go on a trip for a few days. If,

you go away for longer than that it is

easy for a friend to take care of them.

because

6. Lovebirds are also very cheap. They are always

discovering new things that can make you laugh

That

the take.

Again I would like to say lovebirds make great pets!

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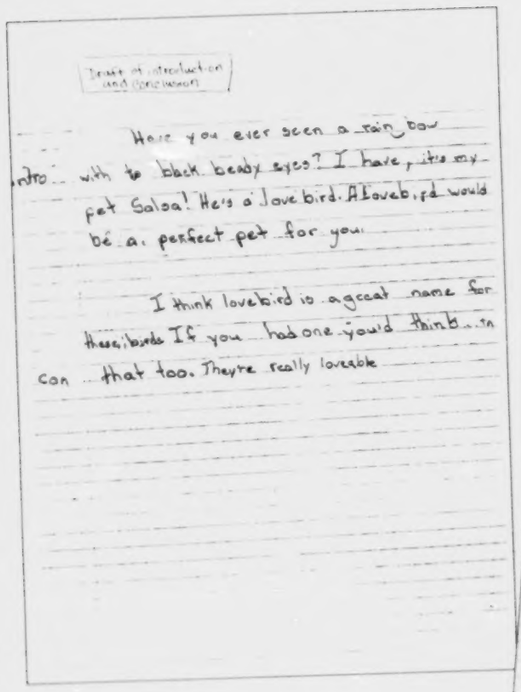
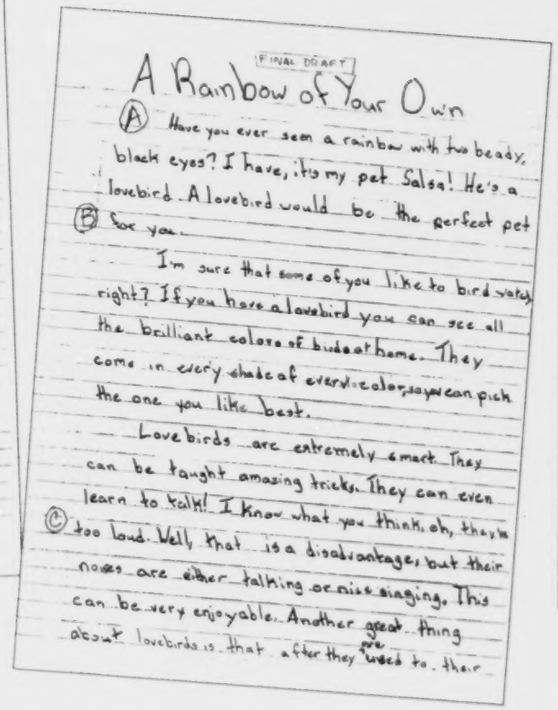


Draft of introduction and first paragraph

intro... Have you ever seen a rainbow with two black beady eyes? I have, it's my pet Salsa! He's a lovebird. A lovebird would be a perfect pet for you.

I think lovebird is a great name for these birds. If you had one you'd think so... can ... that too. They're really loveable.



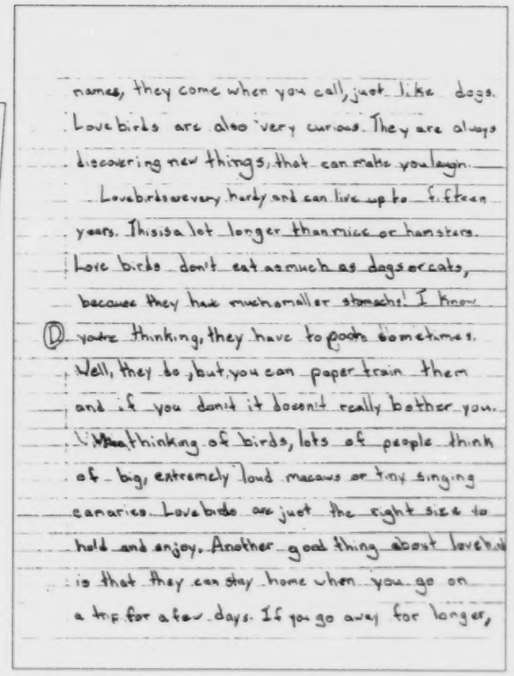
FINAL DRAFT

A Rainbow of Your Own

(A) Have you ever seen a rainbow with two beady, black eyes? I have, it's my pet Salsa! He's a lovebird. A lovebird would be the perfect pet (B) for you.

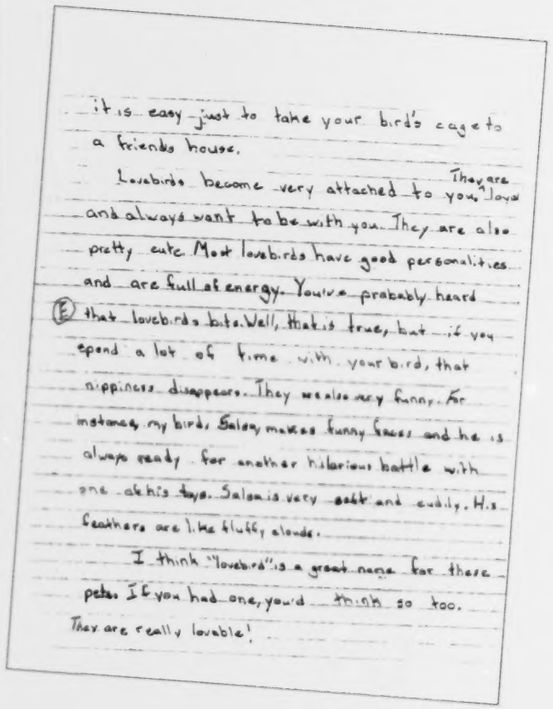
I'm sure that some of you like to bird watch, right? If you have a lovebird you can see all the brilliant colors of birds at home. They come in every shade of every color, so you can pick the one you like best.

Lovebirds are extremely smart. They can be taught amazing tricks. They can even learn to talk! I know what you think, oh, they're (C) too loud. Well, that is a disadvantage, but their noises are either talking or nice singing. This can be very enjoyable. Another great thing about lovebirds is that after they are used to their



names, they come when you call, just like dogs. Lovebirds are also very curious. They are always discovering new things, that can make you laugh.

Lovebirds are very hardy and can live up to fifteen years. This is a lot longer than mice or hamsters. Love birds don't eat as much as dogs or cats, because they have much smaller stomachs! I know (D) you're thinking, they have to poop sometimes. Well, they do, but you can paper train them and if you don't it doesn't really bother you. When thinking of birds, lots of people think of big, extremely loud macaws or tiny singing canaries. Lovebirds are just the right size to hold and enjoy. Another good thing about lovebirds is that they can stay home when you go on a trip for a few days. If you go away for longer,



it is easy just to take your bird's cage to a friends house.

Lovebirds become very attached to you, They are love and always want to be with you. They are also pretty cute. Most lovebirds have good personalities and are full of energy. You've probably heard (E) that lovebirds bite. Well, that is true, but if you spend a lot of time with your bird, that nippiness disappears. They are also very funny. For instance, my bird, Salsa, makes funny faces and he is always ready for another hilarious battle with one of his toys. Salsa is very cute and cuddly. His feathers are like fluffy clouds.

I think "lovebird" is a great name for these pets. If you had one, you'd think so too. They are really loveable!

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Work Sample & Commentary: *Drift Aways*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

An extended project, here, is one that has occurred over a sustained period of time, generally at least one week, and often longer.

English Language Arts required by the task

Students were required to write a poem with strong imagery. Prior to writing their own poems, students spent a week reading from various collections of poem and studying imagery, rhythm, poetic language and form.

Circumstances of performance

	timed assignment
✓	extended project
✓	opportunity for revision
	first draft
✓	revised draft
	teacher generated topic
✓	student generated topic
✓	embedded in class work
	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:

Standard 5, Literature—writes works in specific genres;

Standard 4, Conventions, Grammar, and Usage of the English Language—uses appropriate conventions; analyzes and revises written work

Literature

The student writes works in specific genres that incorporate appropriate literary features.

This poem provides evidence that the student:

- applies poetic devices such as figurative language ("Giant jump"), repetition ("Drift away"), description ("Tiny cat/Giant jump/Three story jump");
- uses line breaks and white space to produce a strong poetic form: "Down, Down, Down";
- demonstrates an understanding of poetic form, e.g., the title is also the last line of the poem and the word "Down" actually descends the page;
- raises powerful questions for readers: How does the "wicked woman" of the final version tie in with the "small cat"? Does she throw the cat from a building? If the writer can hope for the cat's survival, does she also hope for Uncle Jerry's?

Conventions, Grammar, and Usage of the English Language

The student regularly uses, with some teacher assistance, appropriate conventions of the English language, including:

- **spelling;**
- **sentence construction;**
- **paragraph structure;**
- **punctuation;**
- **grammar;**
- **usage.**

This work provides evidence that the student:

- identifies three misspelled words in the second version (see circled words) and corrects them for the final version;
- demonstrates through virtually error free writing the ability to manage the conventions of the English language.

The student analyzes and revises written work, as appropriate, relative to audiences and purposes by:

- **adding or deleting details;**
- **adding or deleting explanations;**
- **clarifying difficult passages;**
- **rearranging words, sentences, and paragraphs to improve or clarify meaning;**
- **sharpening the focus;**
- **reconsidering the organizational structure.**

This work provides evidence that the student:

- makes appropriate and substantive changes from draft to draft, including the rethinking of substantial details that enhance the quality of the poem, e.g., finding a parallel between the loss of the cat and the death of her uncle;
- makes effective changes in the form of the poem, moving from a three stanza format with long fragmentary sentences that replicate prose forms and rhythms and that lack imagery to a four stanza format which uses line breaks and white space to effect mood and rhythm.

Jan. 12, 1995

'Feelings, Drift Aways

When you know you can't forget someone
Because of how you miss them so much,
And no matter how much you try
You can't.

When you know you can't forget someone
Even though because they died,
They're making your life miserable
You can't.

When you know you can't forget someone
Even if you know they can't come back,
But you wish with all your heart they could,
They can't.

To Uncle Jerry, who I
wish would come back
with all my heart,
please, come back.

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Mar. 9, 1995

2 Drift Aways

Wicked women!
Small cat.
Poor (defenceless) creature.
When you know, you can't forget someone
Even if they all of a sudden just drift,
Drift away.

When you know you can't forget someone
Even if there just a cat,
Tiny cat,
Giant jump,
Three story jump,
Down,
Down,
Down,
Into the hole.
Like my Uncle Jerry,
That cat, Bunnie,
Which I still have hope for,
Just drifted away.

Drift aways.

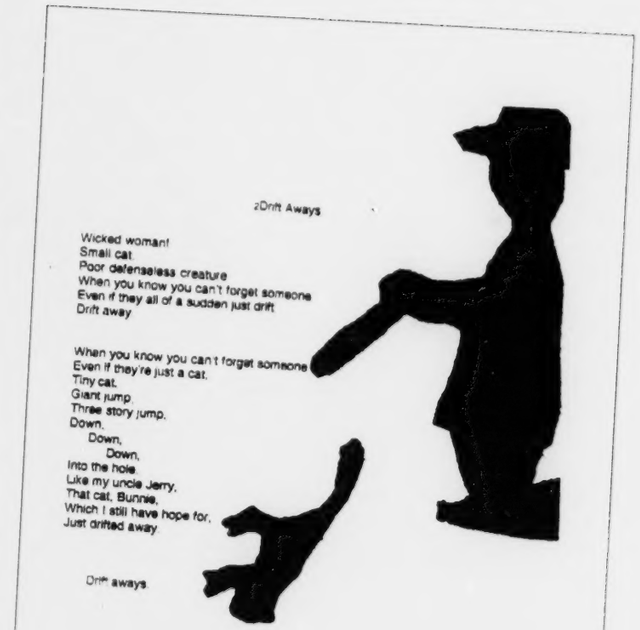
Mar. 9, 1995

2 Drift Aways

Wicked women!
Small cat.
Poor defenseless creature.
When you know, you can't forget someone
Even if they all of a sudden just drift
Drift away.

When you know you can't forget someone
Even if they're just a cat,
Tiny cat,
Giant jump,
Three story jump,
Down,
Down,
Down,
Into the hole.
Like my Uncle Jerry,
That cat, Bunnie,
Which I still have hope for,
Just drifted away.

Drift aways.



2Drift Aways

Wicked woman!
Small cat.
Poor defenseless creature.
When you know you can't forget someone
Even if they all of a sudden just drift
Drift away

When you know you can't forget someone
Even if they're just a cat.
Tiny cat.
Giant jump.
Three story jump.
Down.
Down.
Down.
Into the hole.
Like my uncle Jerry.
That cat, Bunnie.
Which I still have hope for.
Just drifted away.

Drift aways.

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Work Sample & Commentary: *Imagine 1*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

An extended project, here, is one that has occurred over a sustained period of time, generally at least one week, and often longer.

In France, teachers are asked to provide students with the opportunity to "memorize poems taken from the corpus of French poetry; write poems, working within certain freely-chosen constraints; producing an anthology of the poetry produced by students in the class."

Les cycles à l'école primaire, p. 103.

English Language Arts required by the task

Students were required to write a poem with strong imagery. Prior to writing their own poems, students spent a week reading from various collections of poems and studying imagery, rhythm, poetic language and form.

Circumstances of performance

	timed assignment
✓	extended project
✓	opportunity for revision
	first draft
✓	revised draft
	teacher generated topic
✓	student generated topic
✓	embedded in class work
	research required

This work sample provides evidence for the quality of work expected for the following part of the English Language Arts standards:

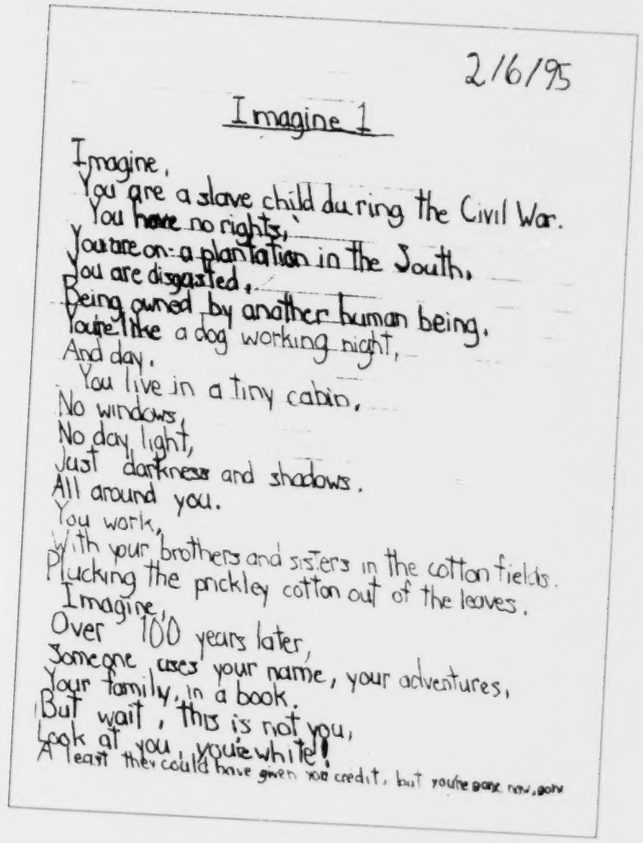
Standard 5, Literature—writes works in specific genres.

Literature

The student writes works in specific genres that incorporate appropriate literary features.

This poem provides evidence that the student:

- works with poetic devices such as simile: "You're like a dog working night,/and day"; alliteration "Plucking the prickley cotton"; and imagery: contrasts the "daylight" with "darkness and shadows";
- uses line breaks and white space to produce an effective poetic form with lines of various lengths;
- effectively captures the feeling of a slave child through powerful imagery: "You live in a tiny cabin./No windows,/No day light,/Just darkness and shadows/All around you.";
- uses repetition to create a sense of elegiac closure: "...but you're gone now, gone".



2/6/95

Imagine 1

Imagine,
You are a slave child during the Civil War.
You have no rights,
You are on a plantation in the South.
You are disgusted,
Being owned by another human being,
You're like a dog working night,
And day,
You live in a tiny cabin,
No windows,
No day light,
Just darkness and shadows,
All around you.
You work,
With your brothers and sisters in the cotton fields.
Plucking the prickley cotton out of the leaves.
Imagine,
Over 100 years later,
Someone uses your name, your adventures,
Your family, in a book.
But wait, this is not you,
Look at you, you're white!
At least they could have given you credit, but you're gone now, gone

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Work Sample & Commentary: *My Life as a Sea Horse*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

English Language Arts required by the task

Students were asked to write about an ocean creature from the ocean creature's point of view.

Circumstances of performance

	timed assignment
✓	extended project
✓	opportunity for revision
	first draft
✓	revised draft
	teacher generated topic
✓	student generated topic
✓	embedded in class work
✓	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:

Standard 1, Reading—reads informational materials;

Standard 2, Writing—produces a report;

Standard 4, Conventions, Grammar, and Usage of the English Language—uses appropriate conventions.

Reading

The student reads informational materials to develop understanding and expertise and produces written and/or oral work that:

- **restates or summarizes information;**
- **relates new information to prior knowledge and experience;**
- **extends ideas;**
- **makes connections to related topics or information.**

This work provides evidence that the student:

- organizes and restates information from a variety of sources in a manner appropriate for an informational piece of writing;
- makes a connection between prior knowledge of reproduction and the reproductive behavior of sea horses;
- works with the information provided to create a connection between that information and the feasibility of having a sea horse as a pet.

Writing

The student produces a report, in which the writer:

- **engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;**
- **develops a controlling idea that conveys a perspective on the subject;**
- **creates an organizing structure appropriate to a specific purpose, audience, and context;**
- **includes appropriate facts and details;**
- **excludes extraneous and inappropriate information;**
- **uses a range of appropriate strategies, such as providing facts and details, describing or analyzing the subject, and narrating a relevant anecdote.**

This work provides evidence that the student:

- establishes a clear persona and maintains it throughout the piece: identifies the persona as a female sea horse; expresses attitudes that are consistent with factual data and also with a distinctive personality, e.g., "Here is the best thing…"; "I think this is very fair…"; refers to physical traits and actions as the persona's traits and actions, e.g., "I'm not a strong swimmer"; "I have a tube-like snout"; and uses the sort of language that is consistent with the use of that personality, e.g., frequent exclamation points, "go with the flow"; "shaped like a… what do you call them? Oh…";
- establishes a context that gives a reason for providing information: uses a framing device that establishes time and place, e.g., "trying to make my way home around a school of fish"; maintains the framing device throughout the piece and refers to the framing device in the conclusion, e.g., "Well, here's my chance to escape…";
- uses a clear organizational structure: groups details into categories, e.g., physical characteristics [par. 3-5]; behavioral patterns [par. 6-7]; reproductive information [par. 8-9]; suitability as a pet [par. 10]; and excludes extraneous details;
- provides a number of details that are scientific, accurate, and interesting to a fourth grade reader [par. 5 and 6]; avoids details that are inconsistent with the persona or inappropriate for the stated purpose: "I'll tell you a little bit about myself".

Conventions, Grammar, and Usage of the English Language

The student regularly uses, with some teacher assistance, appropriate conventions of the English language, including:

- **spelling;**
- **sentence construction;**
- **paragraph structure;**
- **punctuation;**
- **grammar;**
- **usage.**

This work provides evidence that the student:

- demonstrates the management of the conventions of spelling and usage through error free writing;
- manages a variety of sentence constructions; see in particular paragraph one.

My Life as a Sea Horse

Hello! I'm a female seahorse! I'm trying to make my way home around a school of fish but I'm not having very much progress! These new born fish are feisty. Every second, one jumps out at me!

Well, I might as well stop trying and go with the flow. I'm not a strong swimmer. While I'm floating, I'll tell you a little about myself.

First of all, I am a slender fish with a head shaped like a … what do you call them? Oh! It's shaped like a horse's head! Also, I have a monkey's tail.

We seahorses range from one and a half to eight inches long. We are greyish and blend in with our environment.

My body is encircled with many bony rings which represent fused scales. My head is set at a right angle to my body. I have a tube-like snout which I use to suck my food into my toothless mouth. I have bulging eyes on either side of my head.

I swim in an upright position using my back fins. I use my tail to anchor myself to coral, sea anemones or other kinds of water plants. This way I can hide from my enemies.

I live in shallow waters that are warm year round. I have a hearty appetite. I eat small shrimp and other small organisms. I will really eat anything small enough to fit in my mouth.

Here is the best thing about being a female seahorse. I can do something that not many other females can do. I know many human females will envy this. I can lay my eggs in a pouch on my mate's belly. This pouch is called a brood pouch which is like the pouch of a kangaroo. My husband will hatch the eggs for me in eight or more days. I think this is very fair of him. After all, they are his babies, too.

When my babies leave the pouch, they measure about one fourth of an inch but are very active in the water.

Although I can be kept as a pet, I am delicate and need special care. At least two gallons of seawater is what I need. Also I need coral to hook my tail onto. My diet is live foods such as baby brine shrimp. Many people like to keep me as a pet but I have much more fun in the ocean than you could ever dream of.

Well, here's my chance to escape this school of fish. I hope you liked hearing about sea horses! Maybe sometime I could hear more about you humans!

References

Grolier Student's Encyclopedia [illegible]
Compton's Learning Company, 1991 [illegible]
Funk & Wagnalls New Encyclopedia [illegible]
Childcraft - Story of the Sea [illegible]

An extended project, here, is one that has occurred over a sustained period of time, generally at least one week, and often longer.

In France, elementary school children are expected, "while taking account of orthographic and syntactic constraints, to be able to use knowledge acquired through the study of characteristics of different types of texts encountered while reading in producing their own written work."

Les cycles à l'école primaire, p. 45

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Work Sample & Commentary: *Ishi Lived in Sacramento*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

An extended project, here, is one that has occurred over a sustained period of time, generally at least one week, and often longer.

English Language Arts required by the task

Students were asked to write a brief biography about someone they admired who works, lives, or was born in California. The following questions were to be answered in the biography: Who is/was this person? What did he or she do that is/was so important? When was this person in California and is he or she still? Why did you choose this person? This sample is a final draft keyboarded into a computer by the student with help from a parent aide.

Circumstances of performance

	timed assignment
✓	extended project
✓	opportunity for revision
	first draft
✓	revised draft
	teacher generated topic
✓	student generated topic
	embedded in class work
✓	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:
Standard 1, Reading—reads informational materials;
Standard 2, Writing—produces a report.

Reading

The student reads informational materials to develop understanding and expertise and produces written or oral work that:

- **restates or summarizes information;**
- **relates new information to prior knowledge and experience;**
- **extends ideas;**
- **makes connections to related topics or information.**

This work provides evidence that the student restates and summarizes information about a historical figure.

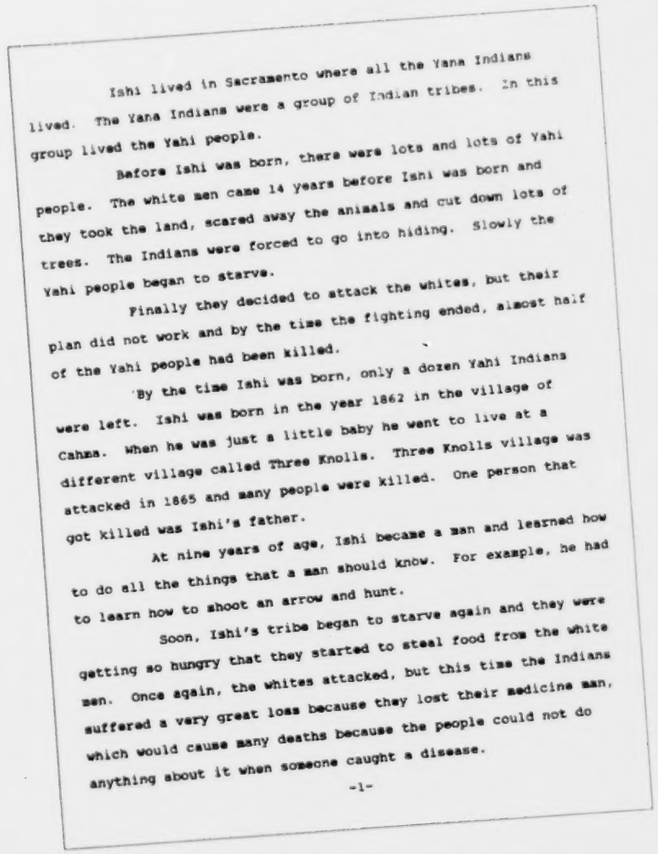
Writing

The student produces a report, in which the writer:

- **engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;**
- **develops a controlling idea that conveys a perspective on the subject;**
- **creates an organizing structure appropriate to a specific purpose, audience, and context;**
- **includes appropriate facts and details;**
- **excludes extraneous and inappropriate information;**
- **uses a range of appropriate strategies, such as providing facts and details, describing or analyzing the subject, and narrating a relevant anecdote.**

This work provides evidence that the student:

- develops reader interest, by connecting the subject, Ishi, to the specific geographical area where the reader's audience lives;
- organizes the biography chronologically, beginning with events prior to Ishi's birth (the coming of European and American settlers, the results of their presence, the battle which decimated Ishi's people), proceeding to Ishi's birth and childhood, his loss of family and companions, his solitary existence, his seeking out white people, his life as a museum exhibit, and ending finally with his death;
- selects appropriate facts and details for the report; the student tells something about the conditions of the Yahi people before Ishi was born, conveys information about Ishi's early life among the few Yahi who remained, relates how Ishi is found and begins to participate in the world of Sacramento in 1911; in addition, the writer chooses effective details to demonstrate Ishi's response to a foreign world;
- narrates a relevant anecdote: how Ishi got his name;
- uses a powerful strategy to conclude by juxtaposing "the slaughterhouse where Ishi was found" with a historical marker.



Ishi lived in Sacramento where all the Yana Indians lived. The Yana Indians were a group of Indian tribes. In this group lived the Yahi people.

Before Ishi was born, there were lots and lots of Yahi people. The white men came 14 years before Ishi was born and they took the land, scared away the animals and cut down lots of trees. The Indians were forced to go into hiding. Slowly the Yahi people began to starve.

Finally they decided to attack the whites, but their plan did not work and by the time the fighting ended, almost half of the Yahi people had been killed.

By the time Ishi was born, only a dozen Yahi Indians were left. Ishi was born in the year 1862 in the village of Cahma. When he was just a little baby he went to live at a different village called Three Knolls. Three Knolls village was attacked in 1865 and many people were killed. One person that got killed was Ishi's father.

At nine years of age, Ishi became a man and learned how to do all the things that a man should know. For example, he had to learn how to shoot an arrow and hunt.

Soon, Ishi's tribe began to starve again and they were getting so hungry that they started to steal food from the white men. Once again, the whites attacked, but this time the Indians suffered a very great loss because they lost their medicine man, which would cause many deaths because the people could not do anything about it when someone caught a disease.

-1-

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Again, they had to leave their village because the whites knew where they were. Even after leaving, the whites still found them and by the end of that battle, there were only five people left in the Yahi tribe. After that, the whites stopped attacking because they thought that all the Yahis were dead. This time they moved to a cave near Deer Creek.

One man that was Ishi's age died from a strange disease and Ishi's mother got very very sick.

Soon the whites found out that the Yahi were living in the cave and they had to leave again, but this time they had nowhere to go. Slowly everyone died, except Ishi. He lived alone with no one to talk to for three years. Finally he decided that he just wanted to die too, so he walked to the closest store or house of a white man and he stopped there for the night. The next morning, he was found in a slaughterhouse and he was brought to jail.

After awhile, he figured out that they were not going to kill him, and he was delighted when they brought him food. One of Ishi's favorite new foods was fruit, but it was very confusing to him because when he was given a banana he would eat it with the peel on, and when he was given a tomato, he started to peel it, and when he was given an orange, he ate it with the peel on.

The newspapers gave him a name, which was "The Wild Man!", and wrote about him a lot.

-2-

After awhile, he began to like the crowds that came to see him every day. He smiled, and sometimes he even made a friend. The whites found out his language by bringing a list of words to see which words he would react to.

A couple of days later, a museum owner asked him to come and be like an exhibit. He said yes and went to live at the museum. To get there, he had to go on a train, which scared him at first but then he got used to it.

Soon after that, he started wearing white men's clothes, but he waited a little while before he started wearing shoes.

By now, everyone wanted to know his name, but Ishi refused to tell. When people began to get impatient, one of his friends said: "Since he will not tell his name, he will be known as Ishi, which means man in Yana language."

In 1914, Ishi went back to visit his home. When he returned, he got very sick and went to the hospital. His friends could see that he was very unhappy in the hospital, so they brought him back to the museum.

-3-

Ishi died in 1916. If it was not for Ishi, the Yahis would never have taken their place in California history. If you go by the slaughterhouse where Ishi was found, you might see a historical marker that says:

The Last Yahi Indian

For thousands of years the Yahi Indians roamed the foothills between Mt. Lassen and the Sacramento Valley. Settlement of the region by white men brought death to the Yahi by gun, by disease, and by hunger. By the turn of the century only a few remained. Ishi, the last known survivor of these people, was discovered at this site in 1911. His death in 1916 brought an end to Stone Age California.

-4-

In New Zealand, to show that they can understand and use written language, students must "identify, discuss, and use the conventions, structures, and language features of different texts, and discuss how they relate to the topic; discuss and convey meanings in written texts, exploring relevant experiences and other points of view; gather, select, record, interpret, and present coherent, structured information from a variety of sources, using different technologies and explaining the processes used."

English in the New Zealand Curriculum, p. 80.

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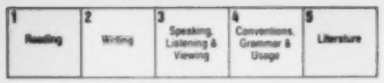
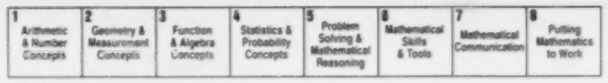
Work Sample & Commentary: *Response to* The Lion, The Witch and The Wardrobe



English Language Arts


1 Arithmetic & Number Concepts
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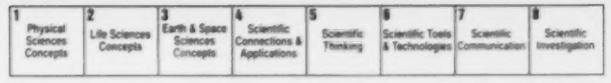
5 Problem Solving & Mathematical Reasoning
6 Mathematical Skills & Tools
7 Mathematical Communication
8 Putting Mathematics to Work

Mathematics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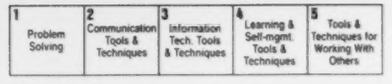
7 Scientific Communication
8 Scientific Investigation

Science


1 Problem Solving
2 Communication Tools & Techniques
3 Information Tech. Tools & Techniques
4 Learning & Self-mgmt. Tools & Techniques
5 Tools & Techniques for Working With Others

Applied Learning

English Language Arts required by the task

Students were asked to write a language and literature log entry in response to a specific passage in *The Lion, The Witch and the Wardrobe* by C. S. Lewis. In this passage the character, Aslan, is introduced both to the reader and to the four Pevensey children: Edmund, Peter, Susan, and Lucy.

Circumstances of performance

	timed assignment
	extended project
	opportunity for revision
✓	first draft
	revised draft
✓	teacher generated topic
	student generated topic
✓	embedded in class work
	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:

Standard 1, Reading—reads and comprehends material; reads in depth;

Standard 5, Literature—responds to fiction, non-fiction, poetry, and drama.

Reading

The student reads and comprehends material of the quality and complexity illustrated in the sample reading list equivalent to twenty-five books each year. The materials should include traditional and contemporary children's literature or the equivalent in children's magazines, newspapers, textbooks, and media, from at least three different literary forms and from at least five different writers. The student produces evidence of reading that:

- **demonstrates a thorough understanding of the text as a whole;**
- **identifies complexities presented in the text, i.e., ideas, information, levels of meaning;**
- **extracts salient information from the text;**
- **uses paraphrasing judiciously.**

This work provides evidence for the quality of work expected for this part of the reading standard. However, to say that the student has met this part of the reading standard, it would be necessary to include additional work of comparable quality.

This work provides evidence that the student:

- comprehends the text in knowing who Aslan is ("I think Aslan is magic and has secret things he can change into.") and then extends the analysis beyond the text ("My mom I think is Aslan in my life because she is always with me and makes me happy.");
- identifies complexities in the characters, e.g., suggests that although the White Witch is "cruel and cold harted [sic]", she is also "a very beautiful person" as a result of her behavior.

The student reads in depth at least four books (or book equivalents) about one issue or subject, or four books by a single writer, or four books in one genre, and produces evidence of reading that:

- **makes and supports warranted and responsible assertions about the texts;**
- **supports assertions with elaborated and convincing evidence;**
- **makes perceptive and well developed connections;**
- **evaluates writing strategies and elements of the author's craft.**

This work provides evidence for the quality of work expected for this part of the reading standard. However, to say that the student has met this part of the reading standard, it would be necessary to include additional work of comparable quality.

This work provides evidence that the student:

- attempts to understand the logic behind the decision to make Aslan a lion ("I think C. S. Lewis picked Aslan to have the form of a lion…") and then offers a critique of that decision ("I think it would have been much cooler if…");
- offers explanations of two fairly complex characters: Aslan, who ("can take your innermost disires [sic] out of you") and the White Witch (who was both "cruel" and "beautiful").

Literature

The student responds to fiction, non-fiction, poetry, and drama using interpretive, critical, and evaluative processes; that is, the student does one or more of the following in oral or written presentations:

- **examines the reasons for a character's actions, taking into account the situation and basic motivation of that character;**
- **identifies recurring themes across works;**
- **identifies stereotypical characters as opposed to fully developed characters;**
- **critiques the degree to which a plot is contrived or realistic;**
- **makes inferences and draws conclusions about context, events, characters, and setting;**
- **analyzes the impact of authors' decisions regarding word choice and content;**
- **considers the function of point of view or persona;**
- **considers the differences among genres;**
- **evaluates literary merit.**

This work provides evidence that the student:

- makes an inference about the text and then supports that inference with evidence from the text: "I think that [Aslan is magic] because when all the kids heard the name Aslan they all got their own special feeling"; "The reason I think that [the cruel witch is beautiful] is because she has to look very pretty and lovely to lure children to come with her into her castel [sic]";
- includes in the interpretation experiences from beyond the text that are consistent with the text: "So if you are usually not so brave and do not like to go on adventures…"; "My mom I think is Aslan in my life because…";
- examines the choices made by the author: "I think C. S. Lewis picked Aslan to have the form of a lion because…"; "I think it would have been much cooler if Aslan wood [sic] have been a made up animal."

A reading log is generally writing done quickly for the sake of identifying the gist of what a student has read and is not usually revised. The spelling and grammatical errors in this work sample do not detract from the overall impression that the student has read the work but would not be acceptable in polished writing, e.g., the word "castel" instead of "castle"; "wood" instead of "would."

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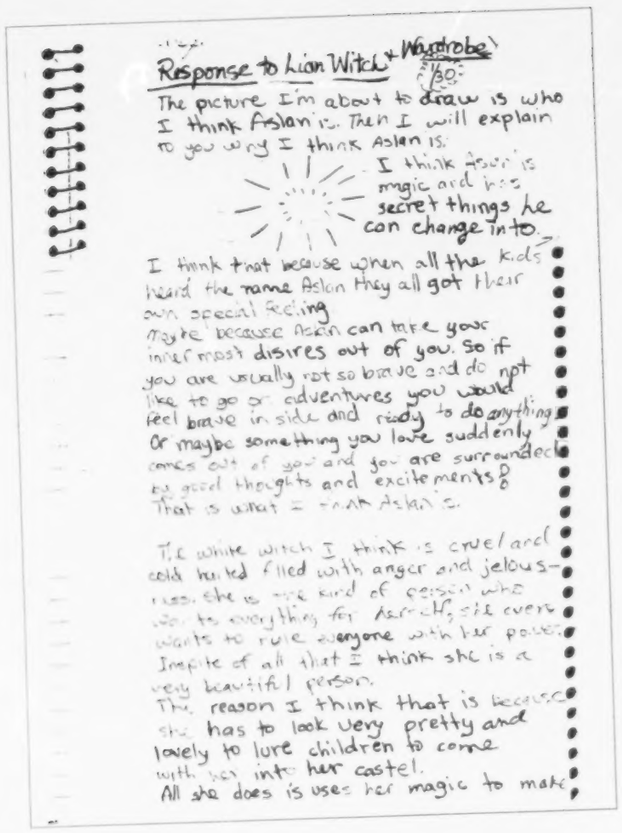


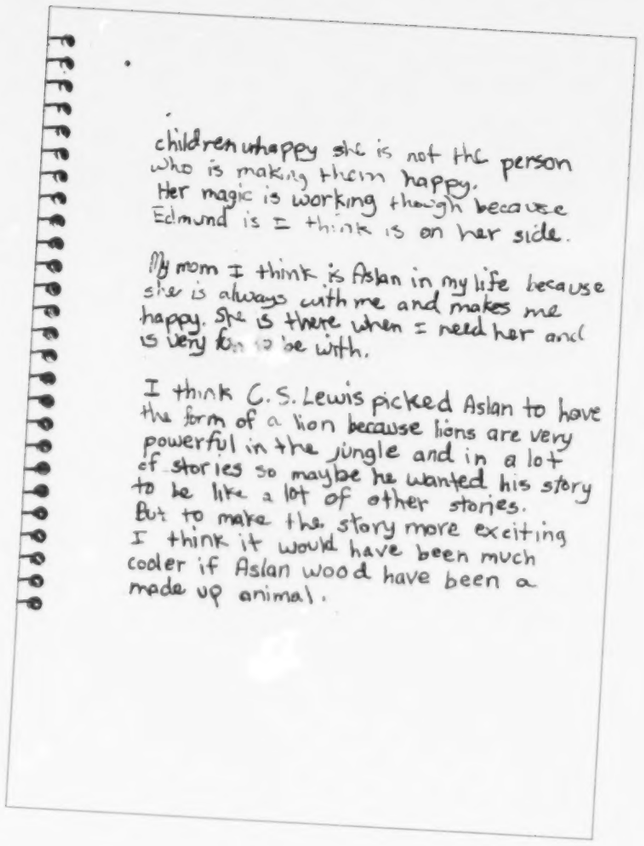
Response to Lion Witch + Wardrobe
/30

The picture I'm about to draw is who I think Aslan is. Then I will explain to you why I think Aslan is.

I think Aslan is magic and has secret things he can change into.

I think that because when all the kids heard the name Aslan they all got their own special feeling
Maybe because Aslan can take your inner most disires out of you. So if you are usually not so brave and do not like to go on adventures you would feel brave inside and ready to do anything. Or maybe something you love suddenly comes out of you and you are surrounded by good thoughts and excitements. That is what I think Aslan is.

The white witch I think is cruel and cold hearted filled with anger and jelousness. She is one kind of person who will do everything for herself she even wants to rule everyone with her power. Inspite of all that I think she is a very beautiful person.
The reason I think that is because she has to look very pretty and lovely to lure children to come with her into her castel.
All she does is uses her magic to make



children unhappy she is not the person who is making them happy.
Her magic is working though because Edmund is I think is on her side.

My mom I think is Aslan in my life because she is always with me and makes me happy. She is there when I need her and is very fun to be with.

I think C.S. Lewis picked Aslan to have the form of a lion because lions are very powerful in the jungle and in a lot of stories so maybe he wanted his story to be like a lot of other stories.
But to make the story more exciting I think it would have been much cooler if Aslan wood have been a made up animal.

An example of achievement objectives in reading for elementary school children in New Zealand asks students, in groups and alone, while reading a text to "make personal notes on aspects that they would like to share, such as related personal experiences, character, piece of action, or specific language features. Individual students develop a written response, or groups, pairs, or individuals shape a presentation to share with larger groups, about an aspect of the text which was important to them."

English in the New Zealand Curriculum, p. 82.

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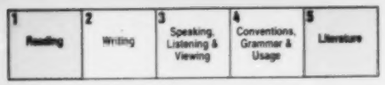
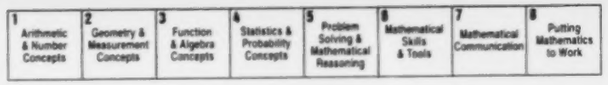
Work Sample & Commentary: *Response to Heidi*



English Language Arts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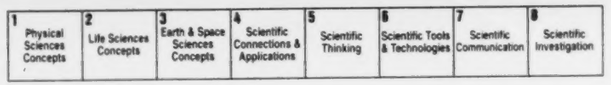
Mathematics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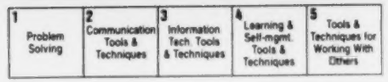
Science


1 Problem Solving
2 Communication Tools & Techniques
3 Information Tech. Tools & Techniques
4 Learning & Self-mgmt. Tools & Techniques
5 Tools & Techniques for Working With Others

Applied Learning

English Language Arts required by the task

Students were required to respond to what they were reading in an independent reading log, choosing from a variety of possible tasks that included predictions, personal responses, character responses, author responses, interpretive questions, note taking, drawings, and story maps.

Circumstances of performance

	timed assignment
	extended project
	opportunity for revision
✓	first draft
	revised draft
	teacher generated topic
✓	student generated topic
✓	embedded in class work
	research required

This work sample provides evidence for the quality of work expected for the following parts of the English Language Arts standards:

Standard 1, Reading—reads and comprehends material; reads in depth;

Standard 5, Literature—responds to fiction, non-fiction, poetry, and drama.

Reading

The student reads and comprehends material of the quality and complexity illustrated in the sample reading list equivalent to twenty-five books each year. The materials should include traditional and contemporary children's literature or the equivalent in children's magazines, newspapers, textbooks, and media, from at least three different literary forms and from at least five different writers. The student produces evidence of reading that:

- **demonstrates a thorough understanding of the text as a whole;**
- **identifies complexities presented in the text, i.e., ideas, information, levels of meaning;**
- **extracts salient information from the text;**
- **uses paraphrasing judiciously.**

This work provides evidence for the quality of work expected for this part of the reading standard. However, to say that the student has met this part of the reading standard, it would be necessary to include additional work of comparable quality.

This work provides evidence that the student:

- tries to deal with complex situations in the text, e.g., Heidi's having to leave her friends and "go live in the city" [Sept. 30 entry]; whether or not Klara's father "is going to like Heidi," and whether "he will let Klara and Heidi keep the kittens that Heidi got from the church" [Oct. 1 entry];
- identifies with the imagery of the book and tries to indicate this in the Sept. 29 and Oct. 3 entries, referring in both to the descriptiveness of the words and the clarity of the images produced by them;
- extracts salient information from the text and then makes connections from the information to events beyond the text: "This reminds me of Sophie and Lena…" [Oct. 2 entry].

The student reads in depth at least four books (or book equivalents) about one issue or subject, or four books by a single writer, or four books in one genre, and produces evidence of reading that:

- **makes and supports warranted and responsible assertions about the texts;**
- **supports assertions with elaborated and convincing evidence;**
- **makes perceptive and well developed connections;**
- **evaluates writing strategies and elements of the author's craft.**

This work provides evidence for the quality of work expected for this part of the reading standard. However, to say that the student has met this part of the reading standard, it would be necessary to include additional work of comparable quality.

This work provides evidence that the student:

- makes an interesting assertion about the main character and then backs it up with an appropriate statement: "I like Heidi a lot because she almost seems to be a goat. She runs wild and free all over the mountain picking wild flowers where ever [sic] she pleases" [Oct. 4 entry];
- makes a perceptive connection to an event beyond the text: "This reminds me of Sophie and Lena…."; and goes on to develop it even further: "Every time Heidi leaves the alm she feels really sad and every time Sophie and Lena leave we feel really sad too" [Oct. 2 entry];
- explores the significance of word choice, e.g., suggests that the choice of the word "leaped" was a significant one in the sentence "Suddenly Peter jumped up and leaped after the goat," "because it doesn't just say, Peter got up and ran after the goats" [Sept. 29 entry]; and comments on a similar difference about another, more complex passage [Oct. 3 entry], again suggesting that word choice matters.

Literature

The student responds to fiction, non-fiction, poetry, and drama using interpretive, critical, and evaluative processes; that is, the student does one or more of the following in oral or written presentations:

- **examines the reasons for a character's actions, taking into account the situation and basic motivation of that character;**
- **identifies recurring themes across works;**
- **identifies stereotypical characters as opposed to fully developed characters;**
- **critiques the degree to which a plot is contrived or realistic;**
- **makes inferences and draws conclusions about context, events, characters, and setting;**
- **analyzes the impact of authors' decisions regarding word choice and content;**
- **considers the function of point of view or persona;**
- **considers the differences among genres;**
- **evaluates literary merit.**

This work provides evidence that the student:

- explores the actions of the main character, e.g., compares her to a goat who "runs wild and free all over the mountain," and then comments that "She is very generous and doesn't think of herself but thinks about others" [Oct. 4 entry];
- infers future actions of a character, e.g., predicts that Klara's father will like Heidi and let the two girls "keep the kittens that Heidi got from the church" [Oct. 1 entry];
- draws conclusions about Heidi's state of mind when she leaves for Frankfurt [Sept. 30 entry];
- infers that a character in the text is like someone known to the writer, e.g., Heidi's feelings on her "travels back and forth from Frankfurt and the alm" are similar to how friends from Wyoming must feel as they "travel back and forth at Christmas time and in the summer" [Oct. 2 entry];
- examines the effect of an author's decisions regarding word choice, e.g., considers the descriptive nature of strong verbs: "jumped" and "leaped" as opposed to "ran" [Sept. 29 entry]; considers how the author "creates a very sharp image in your head" [Oct. 3 entry];
- evaluates and comments upon literary merit through personal responses, e.g., states that she has chosen to read a book that she's already had read to her [Sept. 28 entry]; discloses continued enjoyment of the novel and her opinion that others would like it [Oct. 1 entry]; suggests that the class should read Heidi [Oct. 2 entry].

The spelling and grammatical errors in this work sample do not detract from the overall impression that the student has read the work but would not be acceptable in polished writing.

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Norwegian students are expected to "meet literature as a form of art and share in the common ownership of fictional literature. Literary themes, topics to be covered: Important authors and their works, in relation to their times—brought to life as far as possible."

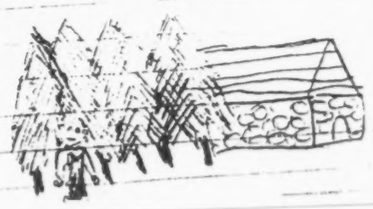
Curriculum Guidelines for Compulsory Education in Norway, p. 149.

Sept 28

Heidi

I just started a new book, tonight. It is called Heidi by Johanna Spyri. My mom already read Heidi to Sally, my sister, and I, but I liked it so much I am going to read it to myself.

Tonight I read pages 4 through 22. I read a chapter. I like this book a lot. It takes place way out in the wilderness up in the alps. I haven't read very much yet.



Note taking/Note Making Sept 29

Heidi

Suddenly Peter Jumped up and leaped after the goats.

I like this sentence alot because it doesn't just say, Peter got up and ran after the goats. It is very descriptive, and you get clear mages of what is going on in the story just then.

Sept 30

Heidi

Tonight I read Pages 56 through 72. I am really enjoying this book and I think everyone in the world shoud read it. I am now at the part in the book where Heidi leaves Peter, Dr. gitte the grandmother and her grandfather with her aunt Dete, to go live with Klara in Frankfurt. It must be sad leaving all her close friends to go live in the city.

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Work Sample & Commentary: *Response to* Heidi *continued*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

Oct 1

Heidi. Predictions

I think that soon Klara's father is going to come home and he is going to like Heidi, I think that he will let Klara and Heidi keep the kittens that Heidi got from the church.

Tonight I read pages 73 through 107. I am really enjoying this book and I think you would too if you read it, but you probably already have.

Oct 2. 1993

Heidi. Personal response

Today I read pages 107 through 175. I am now at part two in the book I am tremendously enjoying this book. It thinks we sould read it all together in class this year.

This reminds me of Sophe and Lena our friends that live in Wyoming. They travel back and forth at Christmas time and in the summer, like Heidi travels back and forth from Frankfurt and the alm.

Every time Heidi leaves the alm she feels really sad and every time Sophie and Lena leave we feel really sad too.

Oct 3 1993

Heidi / Note taking / Note Taking

Today I read pages 175 through 204.

The Mountains were glowing in the early dawn, and the wind was blowing through the firtrees and rocking their old branchs vigorously to and fro.

I like this sentince alot because it doesn't just plainly say, It was a pretty morning and the wind was blowing. It is very discrepeve and it tells what the morning was like very clearly. You get a very sharp image in your head

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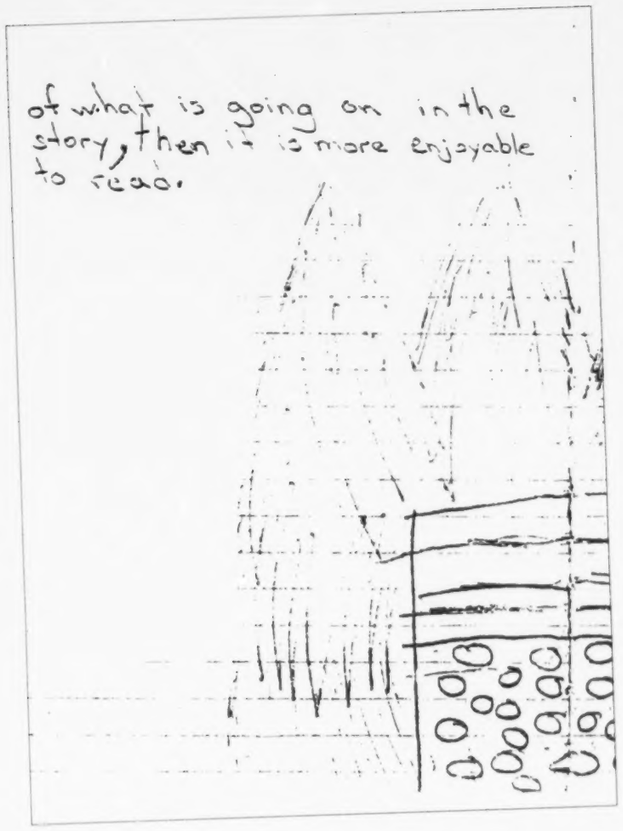
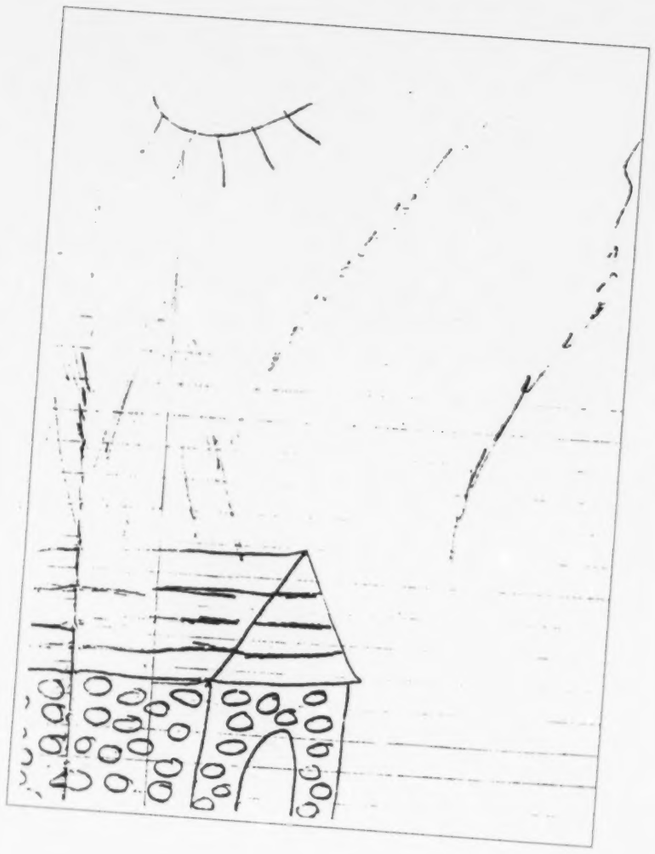
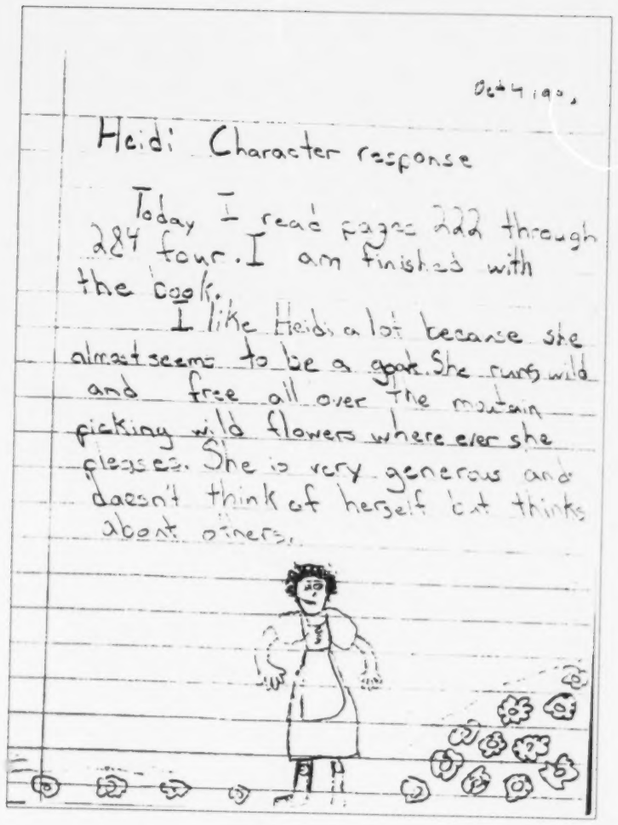

of what is going on in the story, then it is more enjoyable to read.




Oct 4 1995

Heidi Character response

Today I read pages 222 through 284 four. I am finished with the book.

I like Heidi a lot because she almost seems to be a goat. She runs wild and free all over the mountain picking wild flowers where ever she pleases. She is very generous and doesn't think of herself but thinks about others.

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Samples of student work that help explain "how good is good enough" for these standards can be found immediately following these pages.

To see how these performance descriptions compare with the expectations for middle school and high school, turn to pages 90-97.

1. Arithmetic and Number Concepts

The student:

- **adds, subtracts, multiplies, and divides whole numbers, with and without calculators; that is, the student:**
  - **adds, i.e., joins things together, increases;**
  - **subtracts, i.e., takes away, compares, finds the difference;**
  - **multiplies, i.e., uses repeated addition, counts by multiples, combines things that come in groups, makes arrays, uses area models, computes simple scales, uses simple rates;**
  - **divides, i.e., puts things into groups, shares equally; calculates simple rates;**
  - **analyzes problem situations and contexts in order to figure out when to add, subtract, multiply, or divide;**
  - **solves arithmetic problems by relating addition, subtraction, multiplication and division to one another;**
  - **computes answers mentally, e.g., 27 + 45, 30 x 4;**
  - **uses simple concepts of negative numbers, e.g., on a number line, in counting, in temperature, "owing";**
- **demonstrates understanding of the base ten place value system and uses this knowledge to solve arithmetic tasks; that is, the student:**
  - **counts 1, 10, 100 or 1,000 more than or less than, e.g., one less than 100,000, 10 more than 380, 1,000 more than 23,000, 100 less than 9,000, during arithmetic activities and problem solving;**
- **uses knowledge about ones, tens, hundreds and thousands to figure out answers to multiplication and division tasks, e.g. 36 x 10, 18 x 100, 7 x 1,000, 4,000 ÷ 4, during arithmetic activities and problem solving;**
- **estimates, approximates, rounds off, or uses exact numbers, as appropriate, in calculations;**
- **describes and compares quantities by using simple fractions; that is, the student:**
  - **finds simple parts of wholes;**
  - **recognizes simple fractions as instructions to divide, e.g., $\frac{1}{4}$ of something is the same as dividing something by 4;**
  - **recognizes the place of fractions on number lines, e.g., in measurement;**
  - **uses drawings, diagrams, or models to show what the numerator and denominator mean, including when adding like fractions, e.g., $\frac{1}{8} + \frac{5}{8}$;**
  - **uses beginning proportional reasoning and simple ratios, e.g., "about half of the people";**
- **describes and compares quantities by using decimals; that is, the student:**
  - **adds, subtracts, multiplies, and divides money amounts;**
  - **recognizes that decimals are another way of writing fractions, e.g., 0.3 = $\frac{3}{10}$;**
  - **recognizes relationships among simple fractions, decimals, and percents, e.g., that $\frac{1}{2}$ is the same as 0.5, and $\frac{1}{2}$ is the same as 50%;**
- **describes and compares quantities by using whole numbers up to 1,000,000; that is, the student:**
  - **connects ideas of quantities to the real world, e.g., how many people fit in a baseball stadium; how far away is a kilometer in your city;**
  - **finds, identifies, and sorts numbers by their properties, e.g., odd, even; and for two-digit numbers, prime, square, and composite.**

Examples of performances that may demonstrate understanding include:

- estimating reasonably and calculating accurately the number of beans in a cup, seeds in a pumpkin, ceiling tiles in a room, wheels on 37 tricycles;
- showing different coin combinations that make 75¢;
- making up stories that go with number sentences, e.g., 5 x 9 = 45; 27 x 86 = ?;
- explaining many different ways to make 263, using tens, hundreds and ones;
- showing why 3 x 6 = 6 x 3;
- using base ten blocks to solve 43 x 38;
- putting together fraction pieces to make a whole in different ways, e.g., $\frac{1}{10}$ and $\frac{9}{10}$, and $\frac{1}{2}$;
- showing how three pizzas can be shared by four people;
- making approximate counts of different kinds of animals in different zones of a small tide pool area;
- analyzing seasonal variations in temperature, including negative values *(see also Science Standard 3; Applied Learning Standard 1)*;
- organizing a budget for a project *(see also Applied Learning Standard 1)*.

2. Geometry and Measurement Concepts

The student:

- **works with many types of figures and their properties, including angles (right, obtuse, acute), triangles, squares, rectangles, rhombi, parallelograms, quadrilaterals, polygons, prisms, pyramids, cubes, circles, and spheres;**
- **identifies, classifies, and names geometric figures by specific shape properties, e.g., symmetry;**
- **solves problems by showing relationships between and among figures, e.g., using congruence and similarity, and using transformations including flips, slides, and rotations;**
- **extends and creates geometric patterns using concrete and pictorial models;**
- **uses basic ways of measuring the size of figures, including length, width, perimeter, and area;**
- **uses models to reason about the relationship between the perimeter and area of rectangles in simple situations;**
- **selects and uses appropriate units for measuring quantities such as weight, length, area, volume, and time;**
- **carries out simple unit conversions, such as between cm and m, and between hours and minutes;**
- **measures and creates a scale in maps or scale drawings using the idea of constant ratio.**

Examples of performances that may demonstrate understanding include:

- finding all the shapes you can make with five squares if the sides touch completely;
- identifying attributes of triangles;
- creating symmetrical designs with pattern blocks and indicating lines of symmetry;
- figuring out the approximate area and perimeter of the bottom of a shoe;
- putting five objects, such as books, rocks, or pumpkins, in rank order by weight, first by estimating and then by measuring exactly;
- finding all of the rectangular areas (measured in whole square inches) for a particular perimeter, such as 24 in., and seeing if the same pattern of shapes holds for another perimeter.

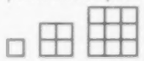
3. Function and Algebra Concepts

The student:

- **uses linear patterns to solve problems; that is, the student:**
  - **shows how one quantity determines another in a linear pattern, i.e. describes, extends, and recognizes the linear pattern by its rule, such as, the total number of legs on a given number of horses can be calculated by counting by fours;**
  - **shows how one quantity determines another quantity in a functional relationship based on a linear pattern, e.g., for the "number of people and total number of eyes," figure out how many eyes 100 people have all together;**
- **builds iterations of simple non-linear patterns, including multiplicative and squaring patterns, with concrete materials and recognizes that these patterns are not linear;**
- **shows that an equality relationship between two quantities remains the same as long as the same change is made to both quantities;**
- **uses letters, boxes, or other symbols to stand for any number, measured quantity, or object in simple situations with concrete materials, i.e., demonstrates understanding and use of a beginning concept of a variable.**

Examples of performances that may demonstrate understanding include:

- finding, making, and describing linear patterns on the 99 chart, e.g., 4, 14, 24, 34;
- observing and recording, in a two-column table, multiplicative patterns with concrete materials, e.g., how many regions are produced by increasing numbers of folds of paper; and recognizing that this type of pattern is not a linear pattern;
- building the fourth, fifth, and sixth iterations in the following sequence; being able to use any given number to make a square number; and recognizing that the number of little squares in this pattern does not proceed in a linear fashion:



- showing how the letters "aab, aab,..." can represent the pattern "metal, metal, plastic,..." "leaf, leaf, rock,..." or many other patterns;
- plotting points on a coordinate graph according to the convention that (x, y) refers to the intersection of a given vertical line and a given horizontal line;
- using variables to show all the ways to make 10 by adding two whole numbers together, i.e., x + y = 10.

4. Statistics and Probability Concepts

The student:

- **collects and organizes data to answer a question or test a hypothesis by comparing sets of data;**
- **displays data in graphs, tables, and charts;**
- **makes statements and draws simple conclusions based on data; that is, the student:**
  - **reads for information data in tables, charts, and graphs;**
  - **compares data in order to make true statements, e.g., "seven plants grew at least 5 cm";**
  - **identifies and uses the mode necessary for making true statements, e.g., "most people chose red";**
  - **makes true statements based on a simple concept of "average" or mean, for a small sample size and where the situation is made evident with concrete materials or clear representations;**
  - **interprets data to determine the reasonableness of statements about the data, e.g., "twice as often," "three times faster";**
  - **uses data, including statements about the data, to make a simple concluding statement about a situation, e.g., "This kind of plant grows better near sunlight because the seven plants that were near the window grew at least 5 cm";**
- **gathers data about an entire group or by sampling group members to understand the concept of "sample," e.g., that a large sample leads to more reliable information;**
- **predicts and finds out why some outcomes are more likely, less likely, or equally likely;**
- **finds all possible combinations and arrangements within certain constraints involving a limited number of variables.**

Examples of performances that may demonstrate understanding include:

- generating survey questions, such as: How many people are in your family? What is your hair color? What is your favorite pizza topping? What do you do at recess?; then predicting survey results, doing the survey, graphing data, and writing true statements about the data;
- figuring out a trend, e.g., the librarian's purchase of new library books and collecting data in order to make a recommendation;
- after sampling, constructing how many raisins are in a given box, taken from a set of boxes, what colors of tiles are in a bag or what fraction of spins will land on a certain space on a given spinner;
- investigating the temperature over the entire school year *(see also Science Standard 3; Applied Learning Standard 1)*;
- investigating the possible and likely or unlikely outcomes when rolling two number cubes and recording the sums;
- finding and recording all combinations of three ice cream flavors and two toppings.

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5. Problem Solving and Mathematical Reasoning

The student solves problems that make significant demands in one or more of these aspects of the solution process: problem formulation, problem implementation, and problem conclusion.

Problem formulation

The student participates in the formulation of problems; that is, given the basic statement of a problem situation, the student:

- makes decisions about the approach, materials, and strategies to use;
- uses previously learned strategies, skills, knowledge, and concepts to make decisions;
- uses strategies, such as using manipulatives or drawing sketches, to model problems;
- does not merely fill in a given chart, use a pre-specified manipulative or go through a predetermined set of steps.

Problem implementation

The student makes the basic choices involved in planning and carrying out a solution; that is, the student:

- makes up and uses a variety of strategies and approaches to solving problems and learns approaches that other people use;
- makes connections among concepts in order to solve problems;
- solves problems in ways that make sense and explains why these ways make sense, e.g., defends the reasoning, explains the solution.

Problem conclusion

The student moves beyond a particular problem by making connections, extensions, and/or generalizations; for example, the student:

- explains a pattern that can be used in similar situations;
- explains how the problem is similar to other problems he or she has solved;
- explains how the mathematics used in the problem is like other concepts in mathematics;
- explains how the problem solution can be applied to other school subjects and in real world situations;
- makes the solution into a general rule that applies to other circumstances.

Examples of problem solving and reasoning include:

- figuring out if a triangle with a 16-inch perimeter, which can be folded in any two places, can always form a triangle;
- figuring out how high a stack of 1,000,000 pennies would be;
- figuring out how many handshakes there would be altogether if five people at a booth were to shake each other's hand just once;
- figuring out the value of each tangram piece if the small tangram triangle is worth one cent and the value is proportional to the area

6. Mathematical Skills and Tools

The student:

- adds, subtracts, multiplies, and divides whole numbers correctly; that is, the student:
  - knows single digit addition, subtraction, multiplication, and division facts;
  - adds and subtracts numbers with several digits;
  - multiplies and divides numbers with one or two digits;
  - multiplies and divides three digit numbers by one digit numbers;
- estimates numerically and spatially;
- measures length, area, perimeter, circumference, diameter, height, weight, and volume accurately in both the customary and metric systems;
- computes time and money; that is the student:
  - computes lengths of time in hours and minutes;
  - calculates money amounts in dollars and cents;
- refers to geometric shapes and terms correctly with concrete objects, including triangle, square, rectangle, rhombus, parallelogram, quadrilateral, polygon, polyhedron, angle (right, acute, obtuse), side, edge, face, cube, vertex, point, line, perimeter, area, volume, circle, diameter, circumference, sphere, prism, and pyramid;
- uses +, −, x, ÷, /, $\sqrt{\ }$, $, ¢, %, and . (decimal point) correctly in number sentences and expressions;
- reads, creates, and represents data on charts, tables, diagrams, bar graphs, simple circle graphs, and coordinate graphs;
- uses recall, mental computations, pencil and paper, measuring devices, mathematics texts, manipulatives, calculators, computers, and advice from peers, as appropriate, to achieve solutions; that is, the student:
  - uses measuring devices, graded appropriately for given situations, such as rulers (customary to the $\frac{1}{16}$ inch; metric to the millimeter), protractors, compasses, graph paper (customary to the inch or half-inch; metric to the centimeter), measuring cups (customary to the ounce; metric to the milliliter), scales (customary to the pound or ounce; metric to the kilogram or gram);
  - interprets long decimals that result from dividing on calculators, by rounding to the nearest appropriate place (whole number, tenth or hundredth).

Examples of mathematical skills and tools include:

- knowing that 6 x 7 = 42;
- mentally adding two-digit numbers correctly during problem solving;
- deciding whether to use a calculator, paper and pencil or mental arithmetic to figure out 6 x 6,000,000;
- calculating correct areas when designing a floor plan for a house;
- using a table to record functions such as how many chairs for at how many tables;
- using a Venn diagram to record students who write a sweater to school and students who walked to school;
- making a bar graph or simple circle graph to show how many students like different kinds of vegetables;
- measuring accurately the circumference of a pumpkin;
- using a calculator to check the arithmetic you did in a project (*see also Applied Learning Standard 1*).

7. Mathematical Communication

The student:

- uses appropriate mathematical terms, vocabulary and language, based on prior conceptual work;
- shows ideas in a variety of ways, including words, numbers, symbols, pictures, charts, graphs, tables, diagrams, and models;
- explains clearly and logically solutions to problems, and supports solutions with evidence, in both oral and written form;
- considers purpose and audience when communicating;
- comprehends mathematics from reading assignments and from other sources.

Examples of mathematical communication include:

- explaining why 34 + 17 ≠ 3417 to a first grader or to a visitor from outer space;
- using words, numbers, or diagrams to explain how to take numbers apart in order to solve problems using mental math; e.g., 25 x 6. One way is "20 x 6 is 120, and 5 x 6 is 30; 120 + 30 = 150." Or, "25 x 4 is 100, and 25 x 2 is 50, and so the answer is 150 because 100 + 50 = 150";
- giving an oral presentation of a preliminary investigation of classification of shapes, in order to get peer feedback, then revising the classification scheme to make it clearer (*see also English Language Arts Standard 3*);
- preparing a report, including graphs, charts, and diagrams, on the optimal number and location of recycling containers, based on data from the classroom and the entire school (*see also Science Standard 7, Applied Learning Standard 1*).

8. Putting Mathematics to Work

The student conducts at least one large scale project each year drawn from the following kinds and, over the course of elementary school, projects drawn from at least three of the kinds.

A single project may draw on more than one of the kinds.

Data study, in which the student:

- develops a question and a hypothesis in a situation where data could help make a decision or recommendation;
- decides on a group or groups to be sampled and makes predictions of the results, with specific percents, fractions, or numbers;
- collects, represents, and displays data in order to help make the decision or recommendation; compares the results with the predictions;
- writes a report that includes recommendations supported by diagrams, charts, and graphs; acknowledges assistance received from parents, peers, and teachers.

Science study, in which the student:

- decides on a specific science question to study and identifies the mathematics that will be used, e.g., measurement;
- develops a prediction (a hypothesis) and develops procedures to test the hypothesis;
- collects and records data; represents and displays data; compares results to predictions;
- writes a report that compares the results with the hypothesis; supports the results with diagrams, charts, and graphs; acknowledges assistance received from parents, peers, and teachers.

Design of a physical structure, in which the student:

- decides on a structure to design, the size and budget constraints, and the scale of design;
- makes a first draft of the design, and revises and improves the design in response to input from peers and teachers;
- makes a final draft and report of the design, drawn and written so that another person could make the structure; acknowledges assistance received from parents, peers, and teachers.

Management and planning, in which the student:

- decides on what to manage or plan and what goal will be used to see if the plan worked;
- identifies unexpected events that could disrupt the plan and further plans for such contingencies;
- identifies resources needed, e.g., materials, money, time, space, and other people;
- writes down a detailed plan; revises and improves the plan in response to feedback from peers and teachers;
- carries out the plan (optional);
- writes up a report on the plan, that includes resources, budget, and schedule; acknowledges assistance received from parents, peers, and teachers.

Pure mathematics investigation, in which the student:

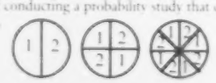
- decides on the area of mathematics to investigate, e.g., numbers, shapes, patterns;
- describes a question or concept that he or she will seek to better understand;
- decides on representations that will be used, e.g., numbers, symbols, diagrams, shapes, or physical models;
- carries out the investigation;
- writes up a report, including generalizations if there were any; acknowledges assistance received from parents, peers, and teachers.

Other kinds of projects involving putting mathematics to work, chosen by the student or teacher, in which the student:

- identifies, with the teacher, and writes down a clear purpose for the project, what will be accomplished, and how the project involves putting mathematics to work;
- develops a question and a plan; writes a detailed description of how the project was carried out, including mathematical analysis of the results; and a report that includes acknowledgment of assistance received from parents, peers, and teachers.

Examples of projects include:

- developing questions and a hypothesis for a study of students' diets; collecting, organizing, displaying, and analyzing the data; and making recommendations to the school community based on the data (*see also Science Standard 4, Applied Learning Standard 1*);
- comparing the growth of a set of plants under a variety of conditions, e.g., amount of water, fertilizer, duration and exposure to sunlight (*see also Science Standard 2*);
- making a design for a tree house that accounts for physical and financial constraints (*see also Applied Learning Standard 1*);
- planning a class camping trip, including making a schedule, researching costs and facilities, developing a budget (*see also Science Standard 2, Applied Learning Standard 1*);
- planning and conducting a probability study that compares the results from three different spinners, e.g.,



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Work Sample & Commentary: *Sharing 25*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

In Nordrhein-Westfalen, one of the Länder in Germany, children are expected to "know the four basic mathematical operations, using children's everyday experiences and touching on practical things that are familiar to them."

Grundschule in Nordrhein-Westfalen, p. 32.

The task

A written prompt told students that four friends want to "share 25 as equally as possible" in three different situations. Students were asked to "show or explain" how to "share 25" in each of the following situations:

- Four friends shared 25 balloons as equally as possible;
- Four friends shared $25 as equally as possible;
- Four friends shared 25 cookies as equally as possible.

Each problem asked students to perform the same operation, to divide 25 by 4, but each context had to be treated differently in order to find a correct solution. The problems were straightforward and require simple solutions.

Circumstances of performance

This task was given as part of a field test for a mathematics examination. Students were expected to spend about five minutes on this set of problems. The examination was unrelated to any curriculum sequence in the classroom, or if it was related, this was a coincidence.

Mathematics required by the task

Students were asked to figure out how 25 of something can be shared by four friends in three different situations. Students had to interpret the requirements of each situation. In particular, students were required to deal with the remainder differently in each division situation. Students were also required to think about the concept of "as equally as possible" and apply this concept to the different situations, each of which will yield a different result, depending on whether or not the objects themselves can be further divided into fractions or decimals. This student's work shows a correct interpretation of the three different situations.

This work sample provides evidence for the quality of work expected for parts of the following Mathematics standards:

Standard 1, Arithmetic and Number Concepts—adds, subtracts, multiplies, and divides whole numbers, with and without calculators;

Standard 6, Mathematical Skills and Tools.

Arithmetic and Number Concepts

The student:

- **adds, subtracts, multiplies, and divides whole numbers, with and without calculators; that is, the student:**
  - **divides, i.e., puts things into groups, shares equally;**
  - **analyzes problem situations and contexts in order to figure out when to add, subtract, multiply, or divide;**
- **estimates, approximates, rounds off, or uses exact numbers, as appropriate, in calculations;**
- **describes and compares quantities by using simple fractions; that is, the student:**
  - **finds simple parts of wholes;**
- **describes and compares quantities by using decimals; that is, the student:**
  - **adds, subtracts, multiplies, and divides money amounts.**

The correct answers show that the student has analyzed the problem situation and has rounded off or used exact numbers as appropriate for each situation. In addition, fractions and decimals have been used correctly.

Mathematical Skills and Tools

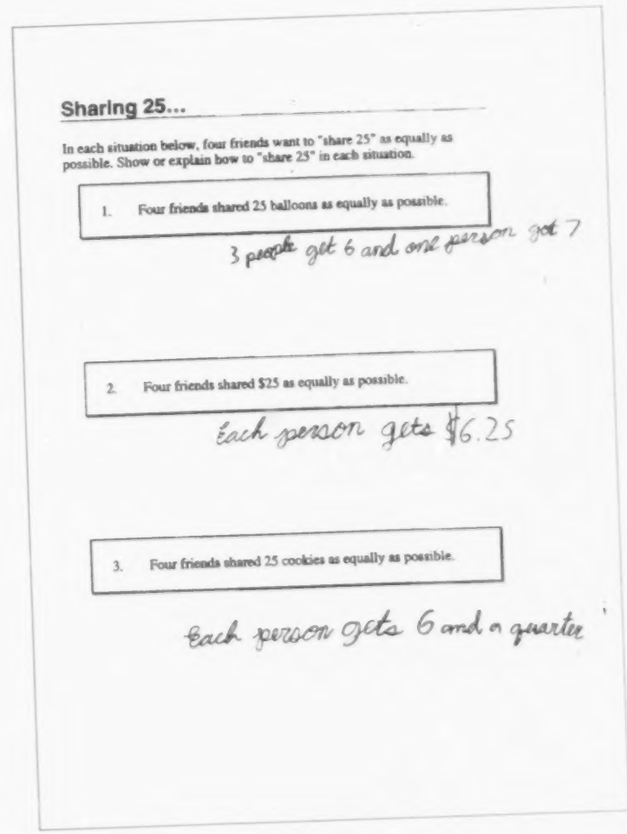
The student:

- **adds, subtracts, multiplies, and divides whole numbers correctly;**
- **computes money; that is the student:**
  - **calculates money amounts in dollars and cents;**
- **uses $ and . (decimal point) correctly.**

Other comments

In an extended time setting, a student could explain more about why the answers in each situation make sense. For example, the student could be asked to explain why the answer to the first situation would not make sense for the second. The student could also be asked to explore what would happen if the numbers could be changed or made larger in the different situations.

As it appears here, this task is appropriate for fourth graders in an on-demand test setting. It focuses their attention on simple concrete problems. If the problem dealt directly with addition, subtraction, or multiplication, larger numbers or more complex situations could be used.



Sharing 25...

In each situation below, four friends want to "share 25" as equally as possible. Show or explain how to "share 25" in each situation.

1. Four friends shared 25 balloons as equally as possible.

3 people get 6 and one person got 7

2. Four friends shared $25 as equally as possible.

Each person gets $6.25

3. Four friends shared 25 cookies as equally as possible.

Each person gets 6 and a quarter

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Work Sample & Commentary: *Multiplication Catalogue*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	Statistics & Probability Concepts	Problem Solving & Mathematical Reasoning	**Mathematical Skills & Tools**	**Mathematical Communication**	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

The task

Over a two month period, students spent approximately two hours per week learning, exploring, and creating different methods to solve two-digit multiplication problems. Using base ten blocks to represent two digit problems was a focus. Students also generated their own algorithms. Working in groups, students shared these algorithms and helped each other learn them. As a culminating activity, students were asked to make a catalogue of six ways that had received a major focus in class discussions and activities.

The teacher explained the directions orally, saying, "Yesterday the class listed six different ways to multiply two-digit numbers on the board, based on your discussion in your groups. Today I'd like you to make a 'catalogue' of all of these ways, that you will be able to refer to as you continue using multiplication. You will also be able to share it with your parents at the upcoming parent-teacher conferences. As always, you must make sure your work is correct, and you must use diagrams and words to explain your thinking. For the 'Circles and Stars' way, you do not need to draw all the circles and stars; it would be too cumbersome." ("Circles and Stars" is a method of drawing m circles with n stars in each, then counting the number of stars to find the product m x n.)

The children were given as much time as they needed to complete the task. Many students wanted to continue working past the hour that had been allocated for the task, including the student whose work is here.

Circumstances of performance

Students were required to work individually and produce individual work. However they sat at tables of four desks and could also discuss their work as they were doing it. The teacher, student teacher, and classroom aide were available for consultation. Students were encouraged to help each other as well. Students had calculators available. However they were encouraged not to use them. Using calculators would defeat the purpose of the task, which was to use mental mathematics strategies to carry out the various methods for solving the multiplication problem.

Mathematics required by the task

Students were asked to choose two two-digit numbers and find their product using several different methods. This task required students to:

- take the numbers apart and put them back together, i.e., decomposition and recomposition of place value components;
- use mental arithmetic;
- group numbers multiplicatively;
- use repeated addition;
- round off numbers;
- represent the place value components of the numbers with diagrams of base ten blocks and in numeral form;
- use algorithms;
- create algorithms;
- explain the methods in words and diagrams.

The work shows how numbers have been taken apart, recombined, and represented in a variety of ways to work through the multiplication problem.

This work sample provides evidence for the quality of work expected for parts of the following Mathematics standards:

Standard 1, Arithmetic and Number Concepts—adds, subtracts, multiplies, and divides whole numbers, with and without calculators;
Standard 6, Mathematical Skills and Tools;
Standard 7, Mathematical Communication.

Arithmetic and Number Concepts

The student:

- **adds, subtracts, multiplies, and divides whole numbers, with and without calculators; that is, the student:**
  - **adds, i.e., joins things together, increases;**
  - **subtracts, i.e., takes away, compares, finds the difference;**
  - **multiplies, i.e., uses repeated addition, counts by multiples, combines things that come in groups, makes arrays, uses area models, computes simple scales, uses simple rates;**
  - **solves arithmetic problems by relating addition, subtraction, multiplication and division to one another;**
  - **computes answers mentally, e.g., 27 + 45, 30 x 4;**
- **demonstrates understanding of the base ten place value system and uses this knowledge to solve arithmetic tasks;**
- **estimates, approximates, rounds off, or uses exact numbers, as appropriate, in calculations.**

The whole piece of work provides evidence for understanding multiplication. The diagrams of base ten blocks and the repeated addition provide evidence of addition and of an understanding of the place value system. The "rounding and subtracting" method provides evidence for subtraction and for relating operations to one another. Subtraction has also been related to addition and multiplication, as is evidenced by the "rounding and subtracting" method.

Mathematical Skills and Tools

The student:

- **adds, subtracts, multiplies and divides whole numbers correctly;**
- **uses +, – and x correctly;**
- **uses recall, mental computations, pencil and paper, manipulatives, and advice from peers, as appropriate, to achieve solutions.**

The work is correct except for small errors in the repeated addition work.

Mathematical Communication

The student:

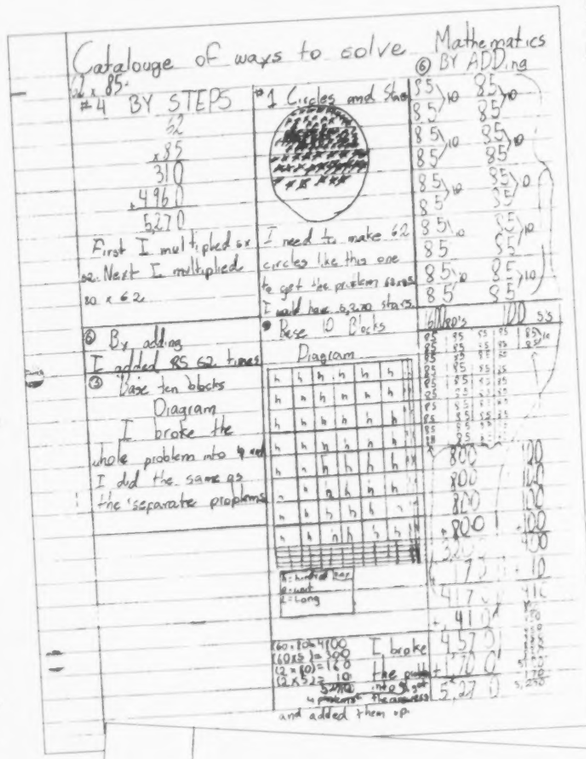
- **shows ideas in a variety of ways, including words, numbers, symbols, pictures, diagrams, and models;**
- **explains solutions to problems clearly and logically, and supports solutions with evidence.**

The writing clearly explains the student's approaches on all parts except the "by adding" part. Diagrams and mathematical symbols are used effectively. The repeated work in addition takes some interpretation to figure out completely. The overall organization of the paper is effective.

Other comments

This task was fully embedded within the curriculum. The skills required for successful completion of this task are at the upper edge of what fourth graders know and can do. Therefore, it would not be appropriate as a high stakes examination question.

The student spells a few words inconsistently, e.g., "multiplied" is correct while "multiplyed" is not; and misspells others, e.g., "Catalouge" instead of "Catalogue." This sample was taken from work done in class, and it was not edited for spelling.


Catalouge of ways to solve Mathematics
BY STEPS
#1 Circles and Sta
I need to make 62 circles like this one to get the problem done I would have 5,270 stars
Base 10 Blocks
Diagram
First I multiplied 85 x 62
Next I multiplied
By adding
I added 85 62 times
Base ten blocks
Diagram
I broke the whole problem into 4 and I did the same as the 'separate problems'
I broke the problem into 4 problems and added them up
Rounding and subtracting
First it rounded 85 to 90. Then it multiply 90 x 62. Next it multiplied 5 x 62.
Then it subtracted 310 from 5580 and got 5,270.

In the Netherlands, students are expected to "develop algorithms for the basic operations gradually, through a process of successive schematization."

The Dutch National Curriculum for Primary School, p. 46

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Work Sample & Commentary: *Pumpkin Activity*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	**Geometry & Measurement Concepts**	Function & Algebra Concepts	Statistics & Probability Concepts	Problem Solving & Mathematical Reasoning	**Mathematical Skills & Tools**	**Mathematical Communication**	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

The task

In this two day project, students working in groups of four estimated and then took measurements of the height, diameter, circumference, and weight of a pumpkin using an inch ruler, a piece of yarn, and a bathroom scale. Each student individually recorded and organized the group's estimated and actual measurements in a chart of his or her own design. Students defined each of the four features being measured and described the methods used to make these measurements. Groups also estimated the number of seeds contained in their pumpkin, decided on a counting method, and then counted. Finally, each student drew reasonable conclusions based on comparisons among the measurement data for all eight groups' pumpkins. The raw data collected from the whole class were recorded on the chalkboard by the teacher.

Circumstances of performance

Students worked with no written prompt. The teacher explained briefly what measurements were to be taken, emphasizing that estimates were to be made first and that each student had to organize and record the estimated and actual measurement data in a form that was clear and organized. In addition, students were asked to explain or represent in some way what each measurement actually meant. Finally, they were asked to write true statements about the data.

Mathematics required by the task

Students were asked to make reasonable estimates and accurate measurements of several features of an irregular physical object (a pumpkin) using appropriate measurement tools, then design a chart or table to communicate the results. Students had to use clear and correct mathematical terms to describe measurement procedures and to write logical statements based on observed connections among the data.

Mathematics evident in this student work

The student response clearly represents the rather extensive data in two well organized charts, along with concise, clear, and multiple descriptions of measurement procedures used.

This work sample provides evidence for the quality of work expected for parts of the following Mathematics standards:

Standard 2, Geometry and Measurement Concepts—uses basic ways of measuring the size of figures;

Standard 6, Mathematical Skills and Tools;

Standard 7, Mathematical Communication.

Geometry and Measurement Concepts

The student:

- **uses basic ways of measuring the size of figures;**
- **selects and uses appropriate units for measuring quantities.**

The student response shows a working understanding of how to measure weight, diameter, circumference, and height, to a reasonable degree of accuracy, using appropriate units. The estimates, the recording of the estimates and the measurements, and the descriptions of the measurement methods all provide evidence for understanding concepts of measurement.

Mathematical Skills and Tools

The student:

- **estimates numerically and spatially;**
- **reads, creates, and represents data on charts, tables, and diagrams.**

The first chart clearly represents the group's estimated and actual data; the eight-by-four matrix clearly represents the whole class data. The student also writes and draws the definition of each type of measurement taken and the procedure used to make the measurement.

Mathematical Communication

The student:

- **uses appropriate mathematical terms, vocabulary and language, based on prior conceptual work;**
- **shows ideas in a variety of ways, including words, numbers, symbols, pictures, charts, tables, diagrams, and models.**

The work shows clear communication, by explaining the process of measurement in multiple ways (words, diagrams, symbolic notation) and by communicating true statements based on the data.

Other comments

While this activity clearly required correct measurement skills, this piece of student work cannot help illustrate the quality of work expected for that part of the standards. The work shows the results of the student's measurement work, but the written work cannot by itself provide evidence that the student measured correctly.

The student misspells a few words in the work. This sample represents work done in class and was not further edited for spelling. The errors are reasonable under the circumstances. Additionally, these particular errors are words that represent relatively new concepts for the student, e.g., "estiment" for "estimate" and "circumfrence" for "circumference."

The following table shows the number of seeds in each pumpkin reported by table groups. The student refers to these data in the "Conclusions" section of the response.

	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8
NUMBER OF SEEDS	369	600	824	738	793	562	233	486

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Measuring Pumpkins

Estimates	Weight	diameter	Circumference	height
Lindsay's Estimate	7½ Pounds	6½ inches	7½ inches	5½ inches
Tom's Estimate	7½ Pounds	6½ inches	22 inches	7½ inches
Allison's estimate	7½ Pounds	6½ inches	22½ inches	5½ inches
Charlie's Estimate	7 Pounds	7 inches	9 inches	7½ inches
Actual Weights	6 Pounds	8 inches	27 inches	7½ inches

Weight

we weighed the Pumpkins by weighing ourself and then the person held the pumpkin and then weighed them both together then we subtracted the person from the pumpkin.

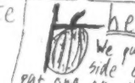
diamiter

first we put two rulers on the sides and then the other on the top and we measured

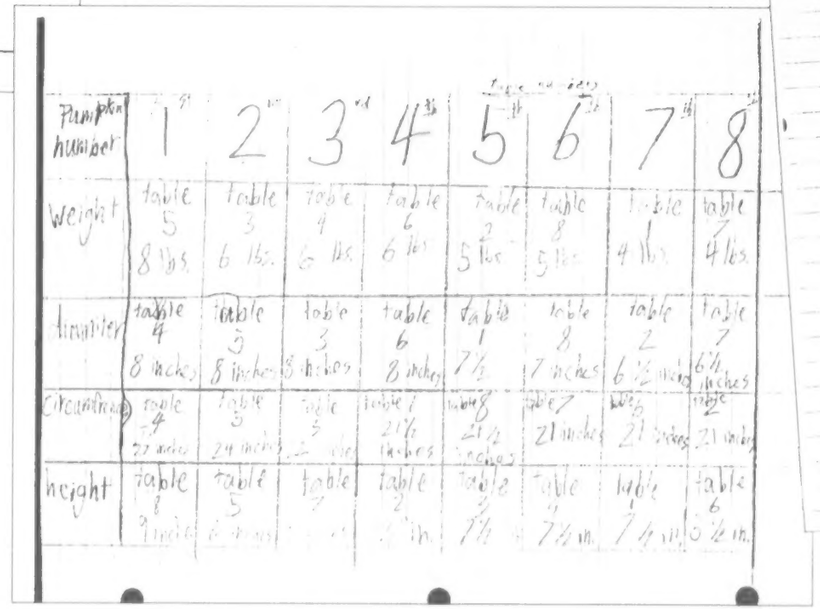
Circumference

We wraped a string around the pumkin then we measured the length of string around the pumpkin and we got the circumference of the pumpkin

height



We put one ruler on the side of the pumpkin then put one on the top then we lined them up and read the one on the side and we got the height of the pumpkin.



Pumpkin number	1st	2nd	3rd	4th	5th	6th	7th	8th
weight	table 5 8 lbs.	table 3 6 lbs.	table 4 6 lbs.	table 6 6 lbs.	table 2 5 lbs.	table 8 5 lbs.	table 1 4 lbs.	table 7 4 lbs.
diameter	table 4 8 inches	table 3 8 inches	table 3 8 inches	table 6 8 inches	table 1 7½	table 8 7 inches	table 2 6½ inches	table 7 6¼ inches
circumference	table 4 27 inches	table 3 24 inches	table 5 [illegible]	table 1 21½ inches	table 8 21½ inches	table 7 21 inches	table 6 21 inches	table 2 21 inches
height	table 8 7 inches	table 5 [illegible]	table 7 [illegible]	table 2 [illegible]	table 3 7½	table 4 7½ in.	table 1 7¼ in.	table 6 5½ in.

1/4/94

Conclusions

Our pumpkin was largest in circumfrence and diamiter. Our pumpkin was table #3 but 6th place in height and 3rd place in # of seeds and weight. Also one of them was 3rd place in height, but last place in diamiter. One of them was last in seeds weight and diamiter, but 2nd place in height, but table 5 was second on all of them accept for weight and it was first in that, Table 6 was 4th in diamiter and weight but last in height. The second heaviest had the most seeds and the heaviest had the second most seeds. Table 6 had 6 pounds, was 8 inches in diamiter but was only 21" in circumfrence and 5½ inches in height.

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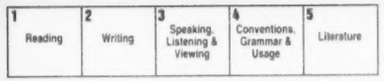
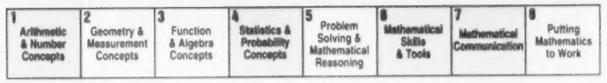
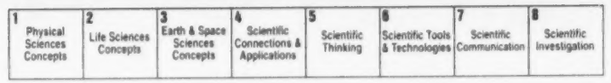
Work Sample & Commentary: *Two Dice Sums*



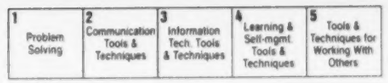
English Language Arts


1 Arithmetic & Number Concepts
2 Geometry & Measurement Concepts
3 Function & Algebra Concepts
4 Statistics & Probability Concepts
5 Problem Solving & Mathematical Reasoning
6 Mathematical Skills & Tools
7 Mathematical Communication
8 Putting Mathematics to Work

Mathematics


1 Physical Sciences Concepts
2 Life Sciences Concepts
3 Earth & Space Sciences Concepts
4 Scientific Connections & Applications
5 Scientific Thinking
6 Scientific Tools & Technologies
7 Scientific Communication
8 Scientific Investigation

Science


1 Problem Solving
2 Communication Tools & Techniques
3 Information Tech. Tools & Techniques
4 Learning & Self-mgmt. Tools & Techniques
5 Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

The task

After having informally explored two dice outcomes, i.e., rolling, noting the result, rolling again, etc., students were given a blank piece of paper. The teacher asked the students to think up a system for finding all combinations for two dice rolled together and to set up that system, providing a title and explanation. After everyone had organized a way of keeping track of the possible pairs, the teacher showed how to begin a six-by-six grid to record all the sums of the possible pairs and asked students to complete it. Again, students were also to describe or explain it. The teacher then instructed the students to: "Write down the possible combinations for each sum as a fraction of 36, i.e., the total number of combined possible outcomes." Students wrote this down in their own way, incorporating the convention for writing fractions. As in the previous diagrams, the students were expected also to provide a title and explanation so that their work was clear.

For the last activity the teacher explained the instructions for the probability game. This game was based on an activity from *A Collection of Math Lessons 3-6*, Marilyn Burns, Math Solution Publications, 1987:

- "Draw a chart with spaces under the sums for two dice (what *are* these numbers?).
- Draw 11 circles in any of the spaces in any combination you want.
- Write the reasons why you put the circles where you did. Try to use fractions to explain your choices.
- With your partner, take turns rolling the dice. When you roll a sum, put Xs in *all* the circles you have for that sum.
- The partner who crosses off all of his or her circles first, wins."

Although the teacher began the recording chart for the students, they were expected to complete it themselves and to supply the appropriate numbers needed. Students played the game several times. After each game students explained why they put the circles where they did and what the result was.

Circumstances of performance

Before working on probability concepts using dice, this class had used colored tiles drawn from a bag to explore related concepts, e.g., likely and unlikely outcomes and making and justifying predictions. Although the students had no previous experience with recording probabilities as fractions, they had worked with other applications of fractions and were familiar with conventional fractional notation.

In the dice activities, students worked with a partner, discussing and sharing ideas but doing their own individual written work. Work was completed in class over the course of two mathematics periods approximately one hour long. Charts and diagrams were created by the students, with the exception of the six-by-six grid and the game recording diagram, which were begun by the teacher but finished and filled in by the students.

Mathematics required by the task

In this short sequence of probability activities, students were asked to find and then organize in writing the outcomes that resulted from rolling two dice. Students then played a probability game and considered the question: based on your probability data, which dice sums will come up most often and why?

In the course of doing these activities, students might infer that by systematically studying and organizing the likelihoods of certain outcomes, good general predictions can be made about future outcomes.

Mathematics evident in this student work

In this student's response, the data (two dice sum outcomes) are carefully and correctly collected and organized, represented as appropriate fractional values, and used to make accurate predictions about future results. The student also clearly explains why some outcomes are more likely, while still understanding that individual outcomes are random.

This work sample provides evidence for the quality of work expected for parts of the following Mathematics standards:

Standard 1, Arithmetic and Number Concepts—describes and compares quantities using simple fractions;

Standard 4, Statistics and Probability Concepts—finds all possible combinations and predicts outcomes;

Standard 6, Mathematical Skills and Tools;

Standard 7, Mathematical Communication.

Statistics and Probability Concepts

The student:

- **predicts and finds out why some outcomes are more likely, less likely, or equally likely;**
- **finds all possible combinations within certain constraints involving a limited number of variables.**

By creating and using an effective systematic listing of the frequencies of certain outcomes (the first three charts), the student is able to choose appropriate and successful strategies in the probability game. In addition, the work provides evidence for an understanding of probability that goes beyond the elementary standard when student writes: "[B]ut I lost even [though] I put most on 7 which comes up $^6/_{36}$ but you're not sure if it'll come up so much because there are others that could come up." This response illustrates that the student has understood that, while some events may have a high theoretical probability, this likelihood does not rule out other events from occurring even if they have a lower probability.

Mathematical Skills and Tools

The student:

- **reads, creates, and represents data on charts, tables, and diagrams.**

The student-created charts (especially the horizontal tables under "Combinations" and the fractions chart) are appropriate, clear, and complete. They allow the student to later use the data contained in the charts to develop strategies and make observations about probable outcomes. The student also correctly completes the teacher-started diagrams, even noting a pattern contained within one of them *(see "Other Comments")*.

Arithmetic and Number Concepts

The student:

- **describes and compares quantities by using simple fractions.**

Mathematical Communication

The student:

- **shows ideas in a variety of ways, including words, numbers, symbols, charts, and tables;**
- **explains clearly and logically solutions to problems and supports solutions with written evidence.**

Although the charts and diagrams are used at the teacher's request, two of the four are entirely of the student's design. The charts are extremely clear and are effective for their purpose. The student's written explanations are sufficiently clear and logical for the elementary level. The student provides evidence in support of the game strategy by referring back to the data contained in the tables: "I put 3 circles on 7 because $^6/_{36}$ of 7 can come up, which is a lot...."

Other comments

These activities were formulated and guided by the teacher. This guidance and instruction allowed students to develop strategies, make observations, and draw conclusions about probability that would have been difficult or impossible for them to demonstrate otherwise. For these reasons this work represents a useful exercise for probability concepts, but it is not an example of problem solving.

When the student offers her explanation of the six-by-six grid, she observes that the frequencies form a diagonal pattern. Had she related this pattern to the frequency of outcomes or to their fractional representations in some way, the work might have additionally illustrated Standard 3, Function and Algebra Concepts.

The student makes several errors in usage and grammar, e.g., "two dices," "loosed" for "lost," and "come" for "came." This was a class assignment and was not intended to be further edited.

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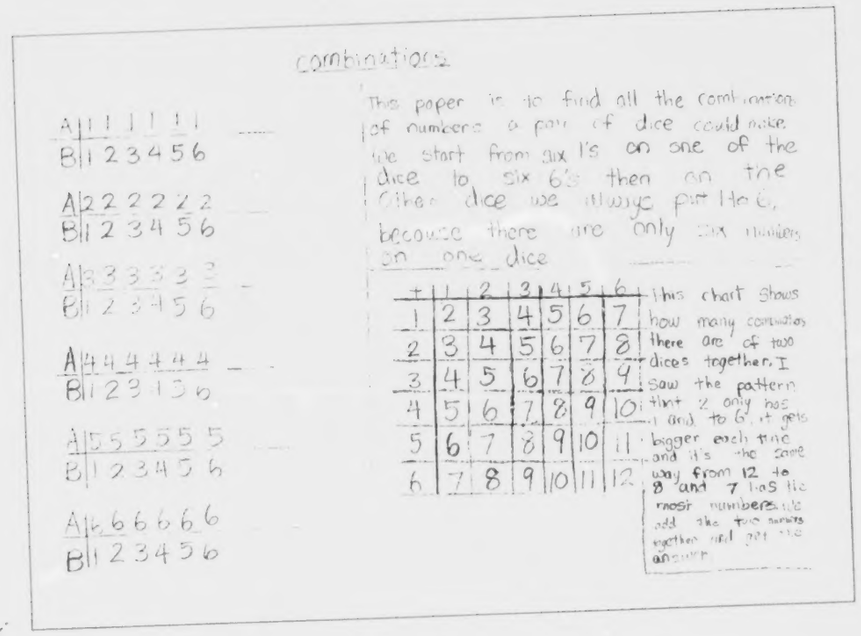
Two Dice Sums



combinations

This paper is to find all the combinations of numbers a pair of dice could make. We start from six 1's on one of the dice to six 6's then on the other dice we always put the 6, because there are only six numbers on one dice

A 1 1 1 1 1 1
B 1 2 3 4 5 6

A 2 2 2 2 2 2
B 1 2 3 4 5 6

A 3 3 3 3 3 3
B 1 2 3 4 5 6

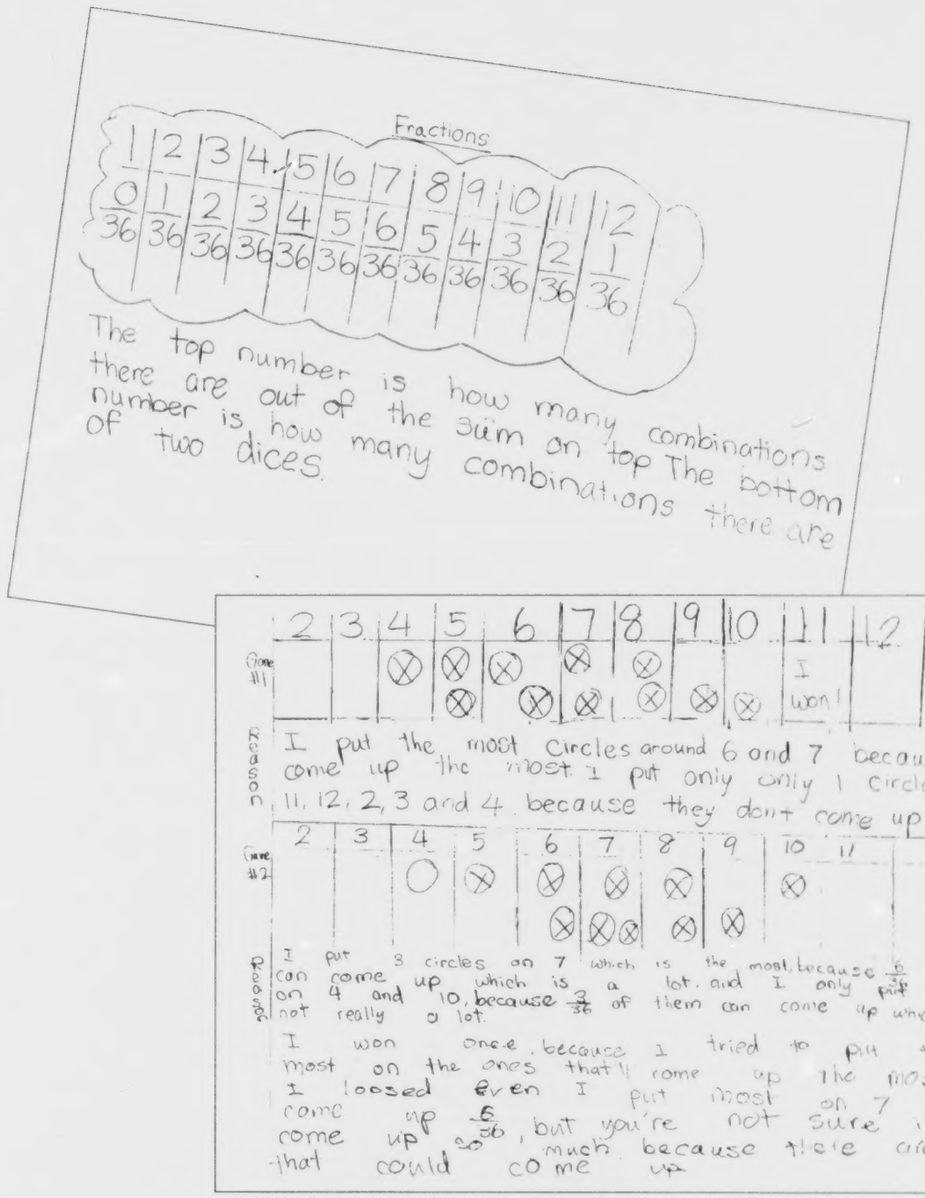
A 4 4 4 4 4 4
B 1 2 3 4 5 6

A 5 5 5 5 5 5
B 1 2 3 4 5 6

A 6 6 6 6 6 6
B 1 2 3 4 5 6

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

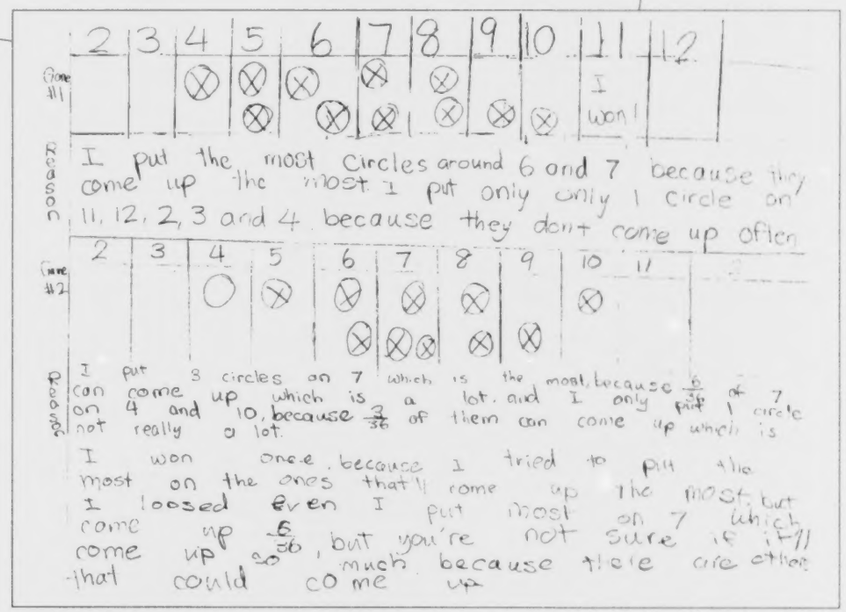
This chart shows how many combinations there are of two dices together. I saw the pattern that 2 only has 1 and to 6 it gets bigger each time and it's the same way from 12 to 8 and 7 has the most numbers. We add the two numbers together and get the answer



Fractions

1	2	3	4	5	6	7	8	9	10	11	12
0/36	1/36	2/36	3/36	4/36	5/36	6/36	5/36	4/36	3/36	2/36	1/36

The top number is how many combinations there are out of the sum on top The bottom number is how many combinations there are of two dices.



	2	3	4	5	6	7	8	9	10	11	12
Game #1	⊗	⊗⊗	⊗⊗	⊗	⊗⊗	⊗	⊗	⊗	⊗	I won!	
Game #2			○	⊗	⊗	⊗⊗	⊗	⊗	⊗	⊗	

Reason

I put the most circles around 6 and 7 because they come up the most. I put only only 1 circle on 11, 12, 2, 3 and 4 because they don't come up often

Reason

I put 3 circles on 7 which is the most, because 6/36 of 7 can come up which is a lot. and I only put 1 circle on 4 and 10, because 3/36 of them can come up which is not really a lot.

I won once, because I tried to put the most on the ones that'll come up the most but I loosed even I put most on 7 which come up 6/36, but you're not sure if it'll come up so much because there are other that could come up

In Ontario elementary schools, students are expected to "collect and organize information related to familiar situations; display and record data; interpret and compare displayed information; predict the probability that a particular event will occur; use concepts of chance to solve problems; apply data-management skills throughout the mathematics curriculum and across other subject areas."

Provincial Standards: Mathematics, p. 31.

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Work Sample & Commentary: *Creatures*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	**Statistics & Probability Concepts**	**Problem Solving & Mathematical Reasoning**	Mathematical Skills & Tools	**Mathematical Communication**	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

The task

Students were presented with the four figures (the Halloween characters of a ghost, witch, skeleton, and pumpkin-headed scarecrow) and asked, "If you could divide each figure into two parts—a head and a body—how many different characters could you possibly come up with by combining the different parts in various ways?"

After students drew the four Halloween characters and cut each into a head and body, the heads were stapled together and the bodies were stapled together, allowing students to flip back and forth to assist in comparing the combinations. The teacher asked the whole class for an example of one possible combination. After brief discussion of one other possibility, the teacher said, "Show and explain in detail all the different combinations you could make with your 'flip book.'"

Circumstances of performance

The task was assigned as a "problem of the week" (P.O.W.). In this classroom a P.O.W. is a two day homework assignment. The students were not provided with written instructions. There had been no prior work dealing with similar discrete or logic tasks.

Mathematics required by the task

This straightforward discrete mathematics problem (finding all possible outcomes or combinations) lends itself to a variety of potentially successful approaches. An essential part of any approach, however, is to use some sort of systematic or organized method, listing, or check to avoid oversights or repetitions. Buried within this question is the more subtle (for elementary students) arithmetic essence of a four (heads) by four (bodies) array or arrangement of possibilities, i.e., $4 \times 4 = 16$.

Mathematics evident in this student work

The student response includes a listing of combinations that is clear, systematic, and fully elaborated enough to allow for a correct answer. Beyond this, the student recognizes and represents the arithmetic underlying the question, in the form of both an array and a labeled number sentence. In addition, the student extends to a similar problem in a different (out of school) context the approach to the (in school) mathematical problem.

This work sample provides evidence for the quality of work expected for parts of the following Mathematics standards:

Standard 4, Statistics and Probability Concepts—finds all possible combinations and arrangements;

Standard 5, Problem Solving and Reasoning;

Standard 7, Mathematical Communication.

Statistics and Probability Concepts

The student's response illustrates the following part of Statistics and Probability Concepts:

- **finds all possible combinations and arrangements within certain constraints involving a limited number of variables.**

Through drawings, words, and diagrams, the student work shows all the possible combinations for four creature heads with four different bodies, demonstrating an understanding of the concept of combinations.

Problem Solving and Mathematical Reasoning

The student's performance also illustrates the following parts of the standard for Problem Solving and Mathematical Reasoning:

Problem implementation

The student makes the basic choices involved in planning and carrying out a solution; that is, the student:

- **makes up and uses a variety of strategies and approaches to solving problems and learns approaches that other people use.**

The student creates a systematic listing in both sentence form and in a diagram.

- **makes connections among concepts in order to solve problems.**

The student discovers the multiplicative relationship underlying this discrete mathematics problem.

- **solves problems in ways that make sense and explains why these ways make sense.**

See, for example, the explanation introduced by "I know my solution is correct because...."

Problem conclusion

The student moves beyond the particular problem by making connections, extensions, and/or generalizations.

See, for example, the following parts of the student work: "This reminded me of..." and "I think if there were 5 cards...."

While the work shows good reasoning for an elementary student, it is important to note that this response cannot alone demonstrate that the student has met the standard for Problem Solving and Mathematical Reasoning. The New Standards' definition of problem solving requires that students' formulate problems as well as solve them.

Problem formulation

The student participates in the formulation of problems; that is, given the basic statement of a problem situation, the student:

- **makes decisions about the approach, materials, and strategies to use;**
- **uses previously learned strategies, skills, knowledge, and concepts to make decisions;**
- **uses strategies, such as using manipulatives or drawing sketches, to model problems.**

The task instructed students to use a flip book. Consequently, decisions about what materials to use and how to model the problem were already made for students. This task is still worthwhile and helps develop students' reasoning and conceptual understanding, and it can be used to assess students in these areas. If the student had, as the standard specifies, used, "previously learned strategies, skills, knowledge, and concepts to make decisions" about how to approach a task, then the response could illustrate the problem formulation part of Problem Solving and Mathematical Reasoning.

Mathematical Communication

The student's response illustrates the following parts of the standard for Mathematical Communication:

- **shows ideas in a variety of ways, including words, numbers, symbols, pictures, charts, graphs, tables, diagrams, and models;**
- **explains solutions to problems clearly and logically, and supports solutions with evidence, in both oral and written form.**

Other comments

This discrete mathematics task is one of several that are commonly used both in the classroom and in on-demand assessment settings. (Other examples of this kind of task ask students to make combinations of pants and shirts or ice-cream cone flavors.)

This student response is distinguished by:

- the completeness and thoroughness with which the student understands the problem;
- the clarity of the solution and explanation;
- the understanding that the student shows of the essential, underlying mathematics, as well as how this mathematics applies to similar situations.

The student misspells several words in the written portion of the work. This was a homework assignment and was not intended to be further edited for spelling.

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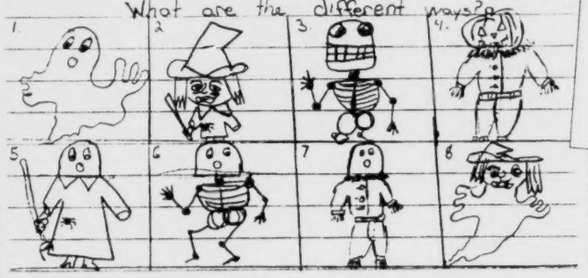
Oct/31/1994

Creatures

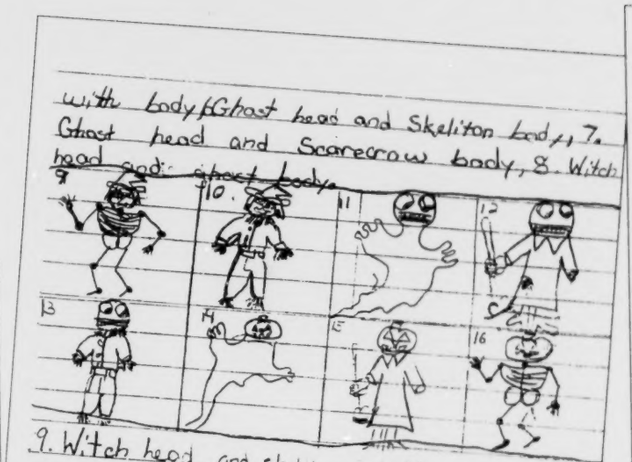
How many creatures can I make with all four pictures?

I am being asked to figure out how many ways can I change the picture.

What are the different ways?



1. Ghost head Ghost body, 2 Witch head and Witch body, 3 Skeliton head and Skeliton body, 4 Pumkin head and Scarecrow body, 5. Ghost head and



with body, 6 Ghost head and Skeliton body, 7. Ghost head and Scarecrow body, 8. Witch head and ghost body.

9. Witch head and skeliton body, 10 Witch head and Scarecrow body, 11 Skeliton head and ghost body, 12 Skeliton head and Witch body, 13 Skeliton head and Scarecrow body, 14 pumkin head and ghost body, 15. Pumkin head and Witch body, and 16. pumkin head and skeliton body.

I figured out the answer by making these cards and making the

body

hole and then filping the different body's with one head and then when I've tryed ever body with that head I switch to the next head.

I got started by filping the stapled back like it says above.

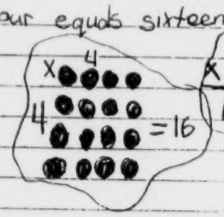
I got stuck drawin the details on the with but other than that I did fine.

I got help by looking at the picture harder.

I did this way because it is easy to understand.

The answer is 16 ways to create a monster with this recipe book.

I know my solution is correct because there are four monsters so that means there are four bodys and four times four equals sixteen.



4 monster heads
X 4 different bodys to put them on
16 different ways.

There is not a different solution (believe me I checked!) unless you make them headless!

This reminded me of a book I have called Croc-gu-plants were you switch the panels and get different weird animals!

I think if there were 5 cards there would be 25 ways!

Japanese students are expected "to develop their abilities to gather, classify and arrange data in accordance with their purposes and to consider their features."

Course of Study for Elementary Schools in Japan, p. 47.

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Work Sample & Commentary: *How Many Handshakes?*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	**Function & Algebra Concepts**	**Statistics & Probability Concepts**	**Problem Solving & Mathematical Reasoning**	Mathematical Skills & Tools	**Mathematical Communication**	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

The task

This problem is an appropriate elementary version of a familiar middle and high school task. The problem is intentionally unformulated. This key element calls on students to create an approach for themselves. The realistic situation is a complex one for an elementary student. While there is one definite solution, there are many possible ways to reach it. A likely common feature of any successful method is using some sort of systematic plan.

Because the students in this class had previous experience working with such unformulated problems, the teacher's instructions were minimal and direct. The problem was not part of a larger unit but rather a situation that proved challenging to the students required to make sense of it.

Circumstances of performance

Students worked independently during one class period, although there was no specific time limit. Students were free to move around the classroom to get materials or to ask clarifying questions of the teacher.

The problem (finding all possible correct combinations) was an unfamiliar one. The challenge was not simply to recognize the type of question and then apply a previously learned specific skill or concept, e.g., "plugging in" numbers, given a table or chart. Instead, the teacher instructed students to remember the important aspects of any good solution to complicated, unformulated problems like this. These important aspects of problem solving had been put into practice by the students throughout the year and could also be referred to by students in written form. So, rather than embedding the problem within a related unit, a specific approach to all problem solving had been embedded into the entire curriculum.

These basic components of good problem solving included, among other things:

- gaining an initial understanding of the problem and working out an approach that might work;
- using a variety of clear mathematical representations in communicating the solution;
- making the response well organized and detailed;
- making a general rule about the solution.

Mathematics required by the task

In this problem the student must find out how many separate, independent handshakes take place among five people if they all shake each other's hand only once. To do this the student needs to come up with a strategy that helps order or organize the possibilities without either repeating or overlooking any of them.

In the process of deciding on and applying an effective strategy, the student may uncover and in some way represent the mathematical essence of the problem: that there is a functional relationship (of the number of handshakes to the number of people) based on a non-linear pattern.

Mathematics evident in this student work

The student's response includes a clear and effective approach that is modeled in two different ways and that arrives at a correct answer. The student then uses the successful problem models to go beyond the original question to solve similar problems, finally making a general rule about all such problems.

This work sample provides evidence for the quality of work expected for parts of the following Mathematics standards:

Standard 3, Function and Algebra Concepts—builds iterations of simple non-linear patterns;

Standard 4, Statistics and Probability Concepts—finds all possible combinations and arrangements;

Standard 5, Problem Solving and Mathematical Reasoning;

Standard 7, Mathematical Communication.

Problem Solving and Mathematical Reasoning

The student solves problems that make significant demands in one or more of these aspects of the solution process: problem formulation, problem implementation, and problem conclusion.

In order to engage in real problem solving, a student must have a real problem to solve. The Handshake problem meets the following basic criteria for a real problem:

- the task is an unfamiliar one, i.e., the student is not simply applying a previously learned solution strategy;
- the task is not formulated for the student, i.e., no approaches, materials, or representations are suggested.

Problem formulation

The student participates in the formulation of problems; that is, given the basic statement of a problem situation, the student:

- **makes decisions about the approach, materials, and strategies to use;**
- **uses previously learned strategies, skills, knowledge, and concepts to make decisions;**
- **uses strategies, such as using manipulatives or drawing sketches, to model problems.**

Problem implementation

The student makes the basic choices involved in planning and carrying out a solution; that is, the student:

- **makes up and uses a variety of strategies and approaches to solve problems and learns approaches that other people use;**
- **makes connections among concepts in order to solve problems;**
- **solves problems in ways that make sense and explains why these ways make sense, e.g., defends the reasoning, explains the solution.**

The work sample provides evidence for making connections among concepts in order to solve problems. For example, it relates the number of possible combinations of handshakes to the non-linear pattern 4 + 3 + 2 + 1.

The work sample provides evidence for explaining in ways that make sense because it defends the reasoning and explains the solution. For example: "At first I made a chart using five bubbles, numbering each. I did this to find the answer. Number one would shake 4, not shaking his own hand..." and "Then I counted the lines and added them and it equaled 10. That is how many handshakes in all."

Problem conclusion

The student moves beyond the particular problem by making connections, extensions, and/or generalizations.

The work makes connections between concepts in order to solve problems, e.g., "I noticed a pattern. Since you don't have 6 shake any hands, you write 5, then add 4 then 3 then...If there were 7 people I would just have to make a math sentence like this: 6 + 5 + 4 + 3 + 2 + 1 = 21" and "A way you can always figure it out, without a chart, is by using a math sentence starting at the highest of your number, or the lowest, going up or down then adding all of them together. Remember not to include the person who can't shake his own hand. For example...."

Function and Algebra Concepts

The student:

- **builds iterations of simple non-linear patterns.**

The student recognizes that five people each shaking each other's hands generate not five but ten handshakes; that six people generate not 12 but 15, etc., and is able to extend the non-linear iterations based on the rule generated by the student.

Statistics and Probability Concepts

The student:

- **finds all possible combinations and arrangements within certain constraints involving a limited number of variables.**

Mathematical Communication

The student:

- **shows ideas in a variety of ways, including words, numbers, pictures, diagrams, and models;**
- **explains solutions to problems clearly and logically, and supports solutions with evidence, in both oral and written form.**

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Other comments

A real problem is both unfamiliar and unformulated. It not always clear or easily determined whether a task poses a real problem. For example, it could be argued that the method the student used to solve this problem is just a way to automatically formulate all unformulated problems, because the students in this class had practiced and internalized a definite, general method to use with such problems. But what the students have internalized are just the important issues to remember whenever addressing any unformulated problem. If a task is unformulated it cannot be formulated by simply applying certain rote procedures or approaches. It requires, as was emphasized in this classroom, "gaining an initial understanding of the problem and working out an approach that might work."

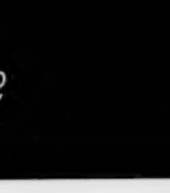
Whether a problem is genuinely unfamiliar to the student who is working it is often a relative question. A particular task may be similar to something a student has experienced in another classroom or outside of class. In such a case, if the task is similar enough it might not be a problem but an exercise of a skill or concept. Some students will be able to make connections from one problem context to another that others are unable to make in a particular situation.

A close inspection of the student's diagrams reveals certain ambiguities and inconsistencies. For example, it is not always clear who shakes whose hand how many times. At other times the syntax of the student's narrative is somewhat confusing. The response, however, is clearly good enough for an elementary student and the meaning is apparent if the reader is careful and patient.

The student misspells several words in the written portion of the work. This was a class assignment and was not intended to be further edited for spelling or grammar.

How Many Handshakes?

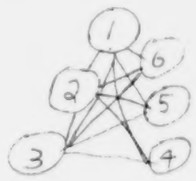
Five people enter a room and introduce themselves to each other. If everyone shakes everyone else's hand just once, what is the total number of handshakes that occurred.



number 1 shakes 4 people
number 2 shakes 3 People
number 3 shakes 2 People
number 4 shakes 1 People
and number 5 shakes 0 People

4+3+2+1=10

At first I made a chart using five bubbles numbering each. I did this to find the answer number one would shake 4 not shaking his own hand. I then drawed four lines to 4, 3, 2 and 1. Then I did the egeact same routine on 4, 3 and 2 and 1. I did not shake any ones hand Then I counted the lines and added them and it equaled 10. That is how many hand shakes in all.



1 shook 5 people hands
2 shook 4 People hands
3 shook 3 People hands
4 shook 2 People hands
5 shook 1 People hands
6 shook no hands

5+4+3+2+1=15

I noticed a pattern. Since you don't have to shake any hands, you write 5, then add 4 then 3 then 2 then 1 and then it equals 15 That pattern helps me to realize not to use a chart on 7 because I can use my way like I did on the pattern. If there where 7 people I would just have to make a math sentence like this:

6+5+4+3+2+1=21

A way you can always figure it out without a chart is by using a math sentence Starting at the highest of your number or the lowest, going up or down then adding all of them together. Remember not to include the person who can't shake his own hand For example if you had 30 people You might start with 29 because 30 cannot shake his own hand. Then you would count down to 1. Then add all the numbers together and that would equal the correct answer

French students in primary schools must "in a variety of situations, recognize, sort, organize and manipulate the data that will be useful in solving a problem; formulate and communicate the processes used and results obtained, argue for the validity of a solution; explain an original process used in an authentic research problem, i.e. a problem for which there is no solution determined ahead of time."

Les cycles 'a l'école primaire, p. 52

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Work Sample & Commentary: *The Great Fish Dilemma*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	Statistics & Probability Concepts	**Problem Solving & Mathematical Reasoning**	Mathematical Skills & Tools	Mathematical Communication	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

The task

A written prompt was presented to students: "How many different ways can you put nine fish in two bowls? Show all your work and at the end explain why you made the decisions you did as you solved the problem." Additionally, a picture was included that showed different kinds of fish, which implied that the student must decide what kind of fish to use while solving the problem.

Circumstances of performance

The task was given as an in-class assignment without possibility of revision. The students could choose to include their work in the Vermont statewide portfolio assessment. They had been instructed in the specific criteria that the Vermont system uses in scoring problem solving work, so they knew what was expected. (See Marge Petit and Beth Hulbert, *Learning How to Show Your Best*, Exemplars, RR1, Box 7390, Underhill, VT 05489).

Mathematics required by the task

Students are asked to figure out all possible combinations for putting nine fish in two bowls. Because it requires problem formulation, the task fits the definition of problem solving found in the description of Standard 5, Problem Solving and Mathematical Reasoning. The task requires students to interpret the problem. For example, students must decide to use one variety of fish or more than one, one size bowl or two. These factors directly influence how the problem can be solved and what mathematics can be used. Students may develop charts or proceed by drawing diagrams and using symbolic or pictorial representations. Students may also choose to use blocks or other manipulatives as a means to solve the problem. By making all of these decisions, students are formulating the problem and thereby engaging in problem solving.

Mathematics evident in this student work

Two samples of student work have been included. Both samples, while using different approaches and developing different solutions, demonstrate successful mathematical problem solving. In addition, both samples show how the concept of systematic lists of all possible combinations can be used to solve problems.

These work samples provide evidence for the quality of work expected for parts of:
Standard 5, Problem Solving and Mathematical Reasoning.

Problem Solving and Mathematical Reasoning:

The student solves problems that make significant demands in one or more of these aspects of the solution process: problem formulation, problem implementation, and problem conclusion.

Problem formulation

The student participates in the formulation of problems; that is, given the basic statement of a problem situation, the student:

- **makes decisions about the approach, materials, and strategies to use;**
- **uses previously learned strategies, skills, knowledge, and concepts to make decisions;**
- **uses strategies, such as using manipulatives or drawing sketches, to model problems.**

Problem implementation

The student makes the basic choices involved in planning and carrying out a solution; that is, the student:

- **makes up and uses a variety of strategies and approaches to solving problems and learns approaches that other people use;**
- **makes connections among concepts in order to solve problems;**
- **solves problems in ways that make sense and explains why these ways make sense, e.g., defends the reasoning, explains the solution.**

Problem conclusion

The student moves beyond a particular problem by making connections, extensions, and/or generalizations.

Both samples demonstrate appropriate reasoning. Each student formulates the problem in a different way, and each models the problem according to the selected formulation. The students are both successful at using strategies flexibly. Connections between number, probability (combinations), and logic concepts are shown in both responses. The students explain why their solutions make sense given the assumptions they have made, e.g., that the fish bowls get cleaned or that some fish might kill each other. Each student also extends and relates the solution to the real world, e.g., "so they have room to move" and "Neons have lots of babies then we'll really be in trouble."

Other comments

While these samples illustrate aspects of number and probability (combination) concepts, as well as clear and logical communication, they were selected for their illustration of problem solving. Successful problem solving builds upon the student's previous learning of concepts and skills. In a problem solving situation, there is a heavy load on reasoning. Thus it may not be appropriate to use the most advanced concepts the student has acquired.

Communication skills are also demonstrated in problem solving whenever the student's reasoning must be clear to the reader. These two samples demonstrate clear communication at levels that can be expected of elementary students. However, there are some instances in which problem solving has taken place, but the student has not been entirely successful at making the piece communicate as clearly as possible.

Each student has misspelled several words, such as "choises" for "choices" and "read" for "red." The work was completed as a class exercise and was not edited to correct spelling mistakes.

Name _____
Date _____

The Great Fish Dilemma

How many different ways can you put nine fish in two bowls?
Show all your work and at the end explain why you made the decisions you did as your solved the problem.

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Sample 1

There are nine fish and I think they are all the same They are goldfish just like the one at my house. I made a chart to solve the problem

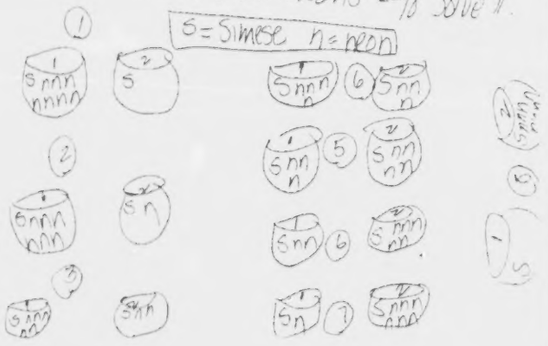
Bowl 1	Bowl 2
0	9
1	8
2	7
3	6
4	5
5	4
6	3
7	2
8	1
9	0

Number of fish

Even though I found 10 possibitys some aren't good. The only reason to put all fish in one bowl is if cleaning other bowl. The best choises are the ones I circled so they have room to move.

Sample 2

We had 9 fish and 2 bowls. Som of the fish are Green. Two of the fish are Simese Fighting fish, and the rest are Neons. The Simese fish can't be togeter ever or they Kill each other The neons can be with anyone. I drew pictures to show my answer. First I used cups and blocks – red for Simese fish and blue for neons – to solve it.



Sample 2 continued

These are all the ways because I found a pattern. The pattern was to put 1 simese fish in each bowl then start a bowl 1 with all the neons and the next time just have 6 neons in bowl 1 and 1 in bowl 2. I always had to put a simese fish in each bowl so I was really only dividing 7 fish (the neons) There are 8 different ways for my problem. Som are to crowded like number 1 and number 8. Neons have lots of babies there will realy be in trubble

"It is not uncommon for the Asian teacher to organize the entire lesson around the solution to a single problem. The teachers leads he children to recognize what is known and what is unknown and directs the students' attention to critical parts of the problem. Teachers are careful to see that the problem is understood by all of the children, and even mechanics, such as mathematical computation, are presented in the context of solving a problem."

Stevenson & Stigler, 1991, *"How Asian Teachers Polish Each Lesson to Perfection"*, p. 15.

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Work Sample & Commentary: *Dream House Project*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	Statistics & Probability Concepts	Problem Solving & Mathematical Reasoning	Mathematical Skills & Tools	Mathematical Communication	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

The task

Students were asked to put mathematics to work in an extended project based on the following question developed by the teacher: "Can you plan and design your own 'dream house,' within certain cost and size constraints?"

Students began with $200,000 (see the piece of student work labeled "Building Contract"), allotting half of that for the land and leaving a $100,000 construction budget. There were two rates for the cost of building:

- "special rooms," requiring special wiring, plumbing, or unusual materials, at the rate of $150 per square foot, e.g., an indoor pool, science lab, or bowling alley;
- "regular rooms", that is, traditional rooms with no special requirements, at a rate of $75 per square foot.

Other specified constraints included:

- all houses must include a kitchen, a bathroom, a living.room, and a bedroom;
- rooms and hallways must have "reasonable" areas, e.g., the student's justification for a room's area might be based on data the class had already collected about room areas (see below for class discussion of data) or on some other defensible basis;
- the overall design must be "convenient" in terms of providing easy access to rooms while still allowing for privacy, calling for thoughtful placement of doors and hallways;
- the number of sides in the floor plan should be limited, avoiding a sprawling, awkward design; this constraint did not specify limits or consequences.

Students first completed a rough draft of the floor plan. Rooms were cut from ¼ inch graph paper to make it easier to keep track of scale area and to make 90 degree corners (scale was ½ inch to one foot). Students maintained a running budget by calculating area and cost and recording it on each room, in addition to keeping a separate running total (see "Budget Update"). All calculations were done by hand and recorded. Students were allowed to use calculators to check calculations and for multiplication with multipliers of three or more digits. As students completed the rough draft, within the constraints and the budget, they met in small response groups to review and give feedback on each others' work. The teacher kept the group focused and recorded on a checklist comments and problems observed by the group (see "House Project Response Group Meeting Notes"). Each student then made any necessary revisions and began the final draft. The final floor plan was drawn with a ruler but without graph paper. This required students to measure rooms accurately and to scale and to keep walls properly perpendicular or parallel.

To complete the project, students described and explained several key concepts and parts of their project according to an outline provided by the teacher (see "Rough Draft Description"). After conferring with a peer editor and then writing the final draft of this description (see "Editing Checklist for House Description"), students used their floor plans to draw front and side views of their homes, using perspective to model three dimensions.

Circumstances of performance

The class had already worked on multiplication with two and three digit multipliers and on the concept of area. They also had experience making representations to scale, e.g., of their classroom or a room they wished to have their own home (see "Scale Model of Room 14" and "Special Room").

Finally, before independently designing their dream houses, students measured areas of rooms in their own homes. Data was collected from all of the students and displayed on line plots in order to get a sense of realistic areas for different kinds of rooms (see "Room Data").

Mathematics required by the task

To complete the project successfully, students had to make decisions, revise, and use extensive mathematics. The essential mathematics required for the project included measuring and rendering accurately, reasoning about trade-offs among certain variables, computing correctly, both with and without a calculator, and working with large numbers.

The project asked each student to make a plan for an affordable and convenient dream house of his or her own design. The plan had to be clear enough so that another person could use it as simple building instructions. Students were to justify the reasonableness of their designs and explain their understanding of the main concepts involved: area, scale, multi-digit multiplication.

Mathematics evident in this student work

The student accurately draws the final draft of the floor plan, using correct measurements and appropriate scale. Calculations are clear and correct, e.g., area, cost, and perimeter. The student communicates clearly and completely her reasoning and her understanding of the mathematics concepts involved.

This work sample provides evidence for the quality of work expected for parts of the following Mathematics standards:

Standard 1, Arithmetic and Number Concepts—adds, subtracts, multiplies, and divides whole numbers, with and without a calculator;

Standard 2, Geometry and Measurement Concepts—uses basic ways of measuring the size of figures;

Standard 5, Problem Solving and Mathematical Reasoning;

Standard 6, Mathematical Skills and Tools;

Standard 7, Mathematical Communication;

Standard 8, Putting Mathematics to Work.

Putting Mathematics to Work

Other types of projects involving putting mathematics to work, chosen by the student or teacher, in which the student:

- **identifies, with the teacher, and writes down a clear purpose for the project, what will be accomplished, and how the project involves putting mathematics to work;**
- **develops a question and a plan; writes a detailed description of how the project was carried out; and a report.**

In this case, the final "Description" serves as a report.

Design of a physical structure, in which the student:

- **decides on the scale of the design;**
- **makes a first draft of the design, and revises and improves the design in response to input from peers and teachers;**
- **makes a final draft and report of the design, drawn and written so that another person could make the structure.**

This task emphasizes revisions of size and budget. See "Mathematics required by the task" for the parts of the design project for which students were responsible.

Arithmetic and Number Concepts

The student:

- **adds, subtracts, multiplies, and divides whole numbers, with and without a calculator;**
- **describes and compares quantities by using whole numbers up to 1,000,000.**

There is ample evidence throughout the project of all four operations being appropriately and correctly used, often with large numbers (up to 100,000). Calculators were used to check computations and for a few two digit-by-three digit multiplication tasks.

Geometry and Measurement Concepts

The student:

- **uses basic ways of measuring the size of figures, including length, width, perimeter, and area;**
- **measures and creates a scale in scale drawings using the idea of constant ratio.**

The work most provides evidence for this standard with respect to calculation of area.

Mathematical Skills and Tools

The student:

- **adds, subtracts, multiplies, and divides whole numbers correctly; that is, the student:**
  - **knows single digit addition, subtraction, multiplication, and division facts;**
  - **multiplies and divides numbers with one or two digits;**
- **measures length, area, and perimeter accurately;**
- **computes money;**
- **reads, creates, and represents data on charts, tables;**

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- **uses recall, mental computations, pencil and paper, a ruler, calculators, and advice from peers, as appropriate, to achieve solutions.**

Pencil and paper are used for long multiplication algorithms. For illustration of "reads, creates, and represents data on charts and tables" in particular, see the student-created data table in "Room Data."

Problem Solving and Mathematical Reasoning

Problem formulation

The student:

- **uses strategies, such as using manipulatives or drawing sketches, to model problems.**

The task called for only limited problem formulation on the part of the student. The teacher in large part formulated and structured the problem. The burden on the student is mainly to model and document the solution, i.e., create the floor plan.

Mathematical Communication

The student:

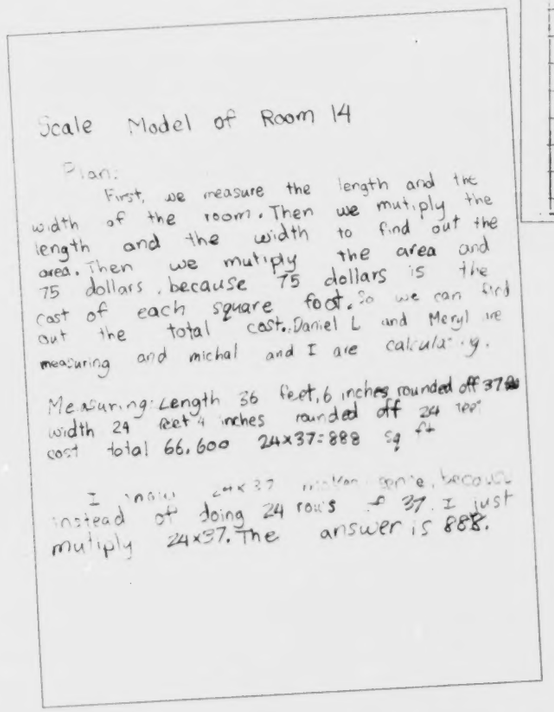
- **shows ideas in a variety of ways, including words, numbers, symbols, charts, tables, and models;**
- **explains clearly and logically solutions to problems, and supports solutions with evidence in both oral and written form.**

Other comments

Drafting to scale a working floor plan for an affordable house asks students to put a considerable body of elementary mathematics to work. An elementary student would not be expected to complete this kind of project without the structuring and support of the teacher or the feedback of peers.

While this work is clear and correct throughout, the student's cautious approach somewhat limits the potential reasoning and problem solving challenge, e.g., avoiding expensive "special rooms" and leaving one-fifth of the budget unspent. Had she tried instead to "get the most dream house for the money," more trade-offs, revision, and recalculating might have been done. While it is important to note that the teacher did not require students to use as much of their budget as possible, such a stipulation would prevent students from taking the easier route that this student chose. It is interesting to speculate in this context about why the student decided not to include any of the five original candidates for "special rooms" listed in the "Building Contract."

The student misspells a few words in the written work. Only the final draft "Description" and floor plan were edited for spelling and grammar. The spelling and grammar errors, such as "mutiply" for "multiply," are reasonable in first draft work.



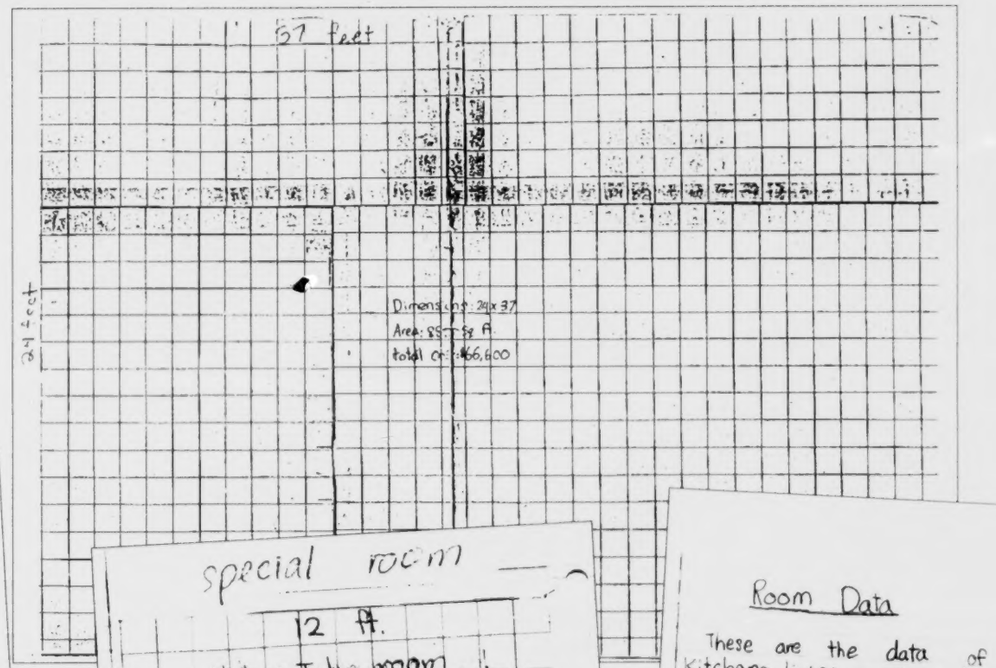
Scale Model of Room 14

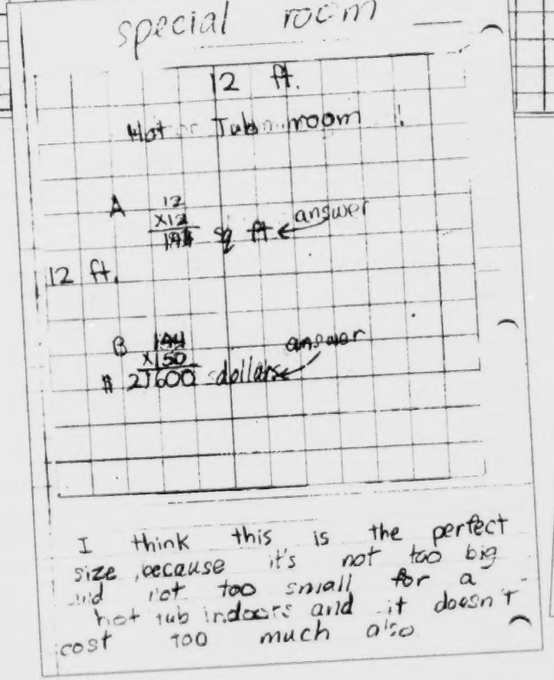
Plan:

First, we measure the length and the width of the room. Then we mutiply the length and the width to find out the area. Then we mutiply the area and 75 dollars, because 75 dollars is the cost of each square foot. So we can find out the total cost. Daniel L and Meryl are measuring and michal and I are calculating.

Measuring: Length 36 feet, 6 inches rounded off 37 ft
width 24 feet 4 inches rounded off 24 ft
cost total 66,600 24×37=888 sq ft

I mutiply 24×37 instead of 24, because instead of doing 24 rows of 37. I just mutiply 24×37. The answer is 888.





special room

12 ft.

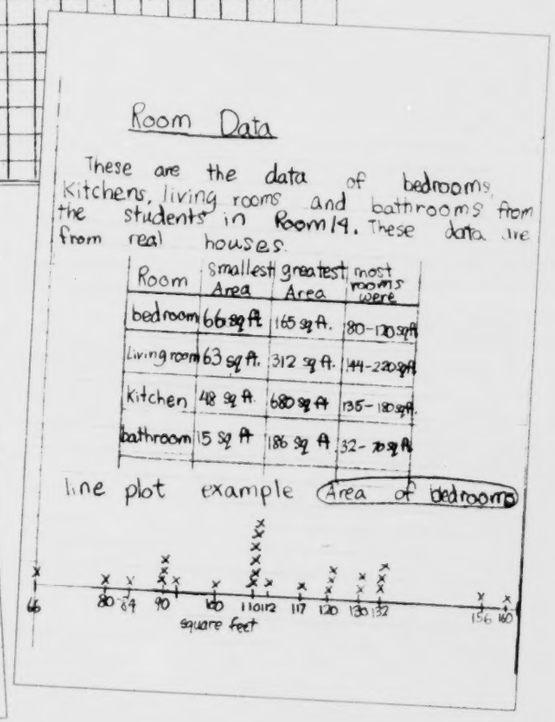
Hot Tub room

A 12 × 12 = 144 sq ft ← answer

12 ft.

B 144 × 150 = 21600 dollars ← answer

I think this is the perfect size, because it's not too big and not too small for a hot tub indoors and it doesn't cost too much also



Room Data

These are the data of bedrooms, Kitchens, living rooms and bathrooms from the students in Room 14. These data are from real houses.

Room	Smallest Area	greatest Area	most rooms were
bedroom	66 sq ft	165 sq ft.	80–120 sq ft
Living room	63 sq ft.	312 sq ft.	144–220 sq ft
Kitchen	48 sq ft.	680 sq ft	135–180 sq ft.
bathroom	15 sq ft	186 sq ft	32–70 sq ft

line plot example Area of bedrooms

Australian teachers are asked to provide elementary students "experiences with problem-solving strategies which enable children to use problem-solving strategies and compare strategies for solving the same problem; clarify mathematical questions and pose related questions; undertake linked sequences of problems, individually and collaboratively."

A National Statement on Mathematics for Australian Schools, p. 44.

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Work Sample & Commentary: *Dream House Project continued*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

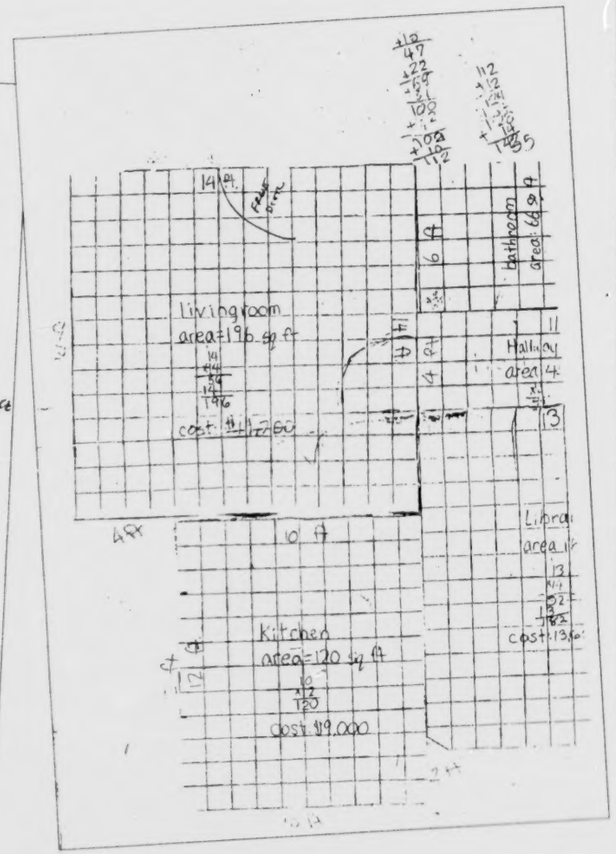
1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

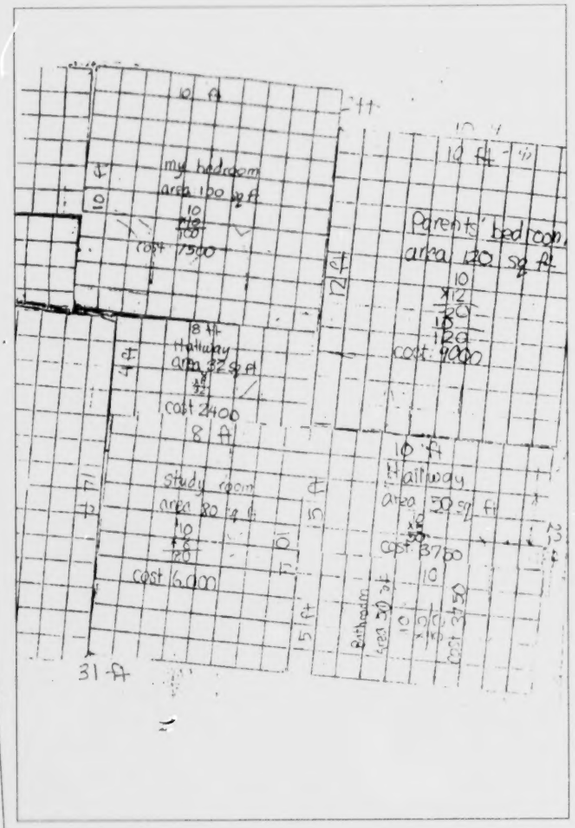
Applied Learning

Building Contract

- Name of homeowner: _____
- Total budget: $200,000
- Cost of land: $100,000
- Amount left to spend on house construction: $100,000
- Rooms required by room 14 code:
  - 1 bedroom (at least)
  - kitchen
  - living room
  - bathroom
- Cost to build regular rooms per square foot: $75 /sq ft
- All rooms that need special materials or extra work are called 'special rooms' These rooms cost twice as much to build.
  Cost of special rooms: $150 /sq. ft.
- List some 'special rooms' you may want:
  - waterslid ~~slash~~ pool room
  - pet room
  - icecream room
  - snow room
  - playground room
  - camping room
- I agree to plan and design my house according to this contract.

_____





BUDGET UPDATE

Name _____

Required Room	Area	Cost
· bathroom	45 sq ft	3375 00
· bedroom	100 sq ft	7500 00
· kitchen	120 sq ft	9000 00
· livingroom	196 sq ft	14700 00

Total cost of 4 required rooms (SHOW CALCULATIONS)

3375
7500
9000
14700
34575

3375+7500+9000+14700=34575

answer

Amount of your building budget that is left (SHOW CALCULATIONS)

200000
34575
65425

200 000-34575=165425

answer

Other room	Area	Cost per sq ft	Cost	Budget Remaining
Library	82 sq ft	75 00	13650	51775
study room	80 sq ft	75 00	6000	45775

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What is the exact amount of have left in my budget?

14700
+13650
28350
1000
+6000
43350
3750
+4950
52050
3300
1500
62850
-9960
3750
+2400
78900

100000
- 78900
21100

HOUSE PROJECT RESPONSE GROUP MEETING NOTES

Name: _____

- Are all the required rooms present? YES ☑ NO ☐, needs _____
- Are the areas for the rooms realistic? (OK)
- Is the perimeter of the house (the outside walls) simple or complicated? (How many sides does house have?) (O.K.)
- Are rooms, hallways and doors convenient?
- Exactly how much budget is left over? $21,100
- NEXT STEPS:
  - What will you revise about your house plan?
    I will revise nothing about my house plan
  - If you are not revising anything, why not?
    because I had done everything right and [The Teacher] had checked it and he thinks everything is "O.K."

Name: _____

House Project - ROUGH DRAFT DESCRIPTION

Q #1: Explain the project.... What is this? What's it about? How much did you have to spend? How much does one square foot cost? What rooms did you have to have? Was the land free? What is the SCALE (how long is one foot on your plan?)

The project is a house project. It's about building our own dream house. The total we could spend for our house is 100,000.00 and the land cost $100,000.00 too (the land is not free of course) so all together including the house and the land it cost $200,000.00. one square foot cost 75.00 for a regular room like a bedroom or a livingroom but one square foot cost 150.00 for a special room like a swimming pool. ½ inch is 1 square foot.

Q #2: Explain about AREA.... What is area? What units do you use to measure area? Give a clear example - use one of your rooms to explain how you know how to figure out the area....

Area is how big is the whole thing. We use square foot as a unit. My bedroom is 100 square feet, I did it by mutiplying it. I count how many squares are on one side and then, I count how many squares are on the top, then I mutiply it together and I get the answer of the whole room. I do that with the other rooms too. The answer I got of every room is how many square feet there are.

Q #3: Show how you know how to use 2-digit multiplication to calculate a room's area.... (like 16 ft. x 12 ft.). Show how to figure out how much a room costs (explain clearly... If you used a calculator, explain how.... Explain how you could still figure it out even without a calculator)

(diagrams) (numbers) (pictures) (words)

If one of my room is 13 ft x 14 ft. I first do 3x4=12. 30 I write the 2 and add the 10 to the 10x4 which is 40, but if I add a 10 to the 40 it'll be 50 so I write the 5 on the left side of 2, it's 52 Then I do 10x10 equals to 30 I write the 3 under the 5 on top from 52. Then I do 10x10=100 and I write the 1 on the left side of 3 Then I add the 52 and 130 together and I got the answer of 182 sq ft. Here's what it looks like.

13
x14
52
13
182

To find out the cost of a regular room you mutiply the total sq ft to 75.00 because each square foot of a regular room is 75.00 so I do the total square foot of the room times 75.00 and if it's a special room you also use the total square feet of that room times 150.00 because that's how much one square foot cost of a special room

Q #4: Explain how you know that your rooms have a reasonable area (you can use the notes you already have on the back of your first draft rooms... Just give a few examples - you don't need to explain about every room)

I know my rooms have a reasonable area because I looked at the rooms chart that my class had made. those rooms are real rooms that the class had measured. Anyway, I compared my rooms to the charts the class had made and see if it is too big or too small or perfect. my rooms always turnns out to be perfect and another way I could tell is by cutting out fake furnitures to put in the rooms and see if it fits.

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Work Sample & Commentary: *Dream House Project* continued

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

Q #5: Explain:
- How many square feet does your finished house have?
- How much does it cost, altogether? (explain where your calculations are so they can be looked at)
- How much money is leftover in your budget?
(explain how you figured this out)

My finished house have 1052 square feet because I added up every room's total square feet and I got the answer. Then I check it with the other paper where I wrote down my exact square feet of my whole house and it's the same. Then I time 1052 with 75, because that's how many square feet each square feet cost. I used the calculator I got the answer of 78000 00, that's how much money I spend. I used the calculator. I still have 22000 00 left. I used the calculator but I also have those answer in the other sheet of paper. The whole perimeter of my house is 142 ft. I did it by counting the walls of my house.

EDITING CHECKLIST FOR HOUSE DESCRIPTION

Name: _____
Editing partner: Annie
Date: 3-29-95

Q #1:
- ✓ Uses complete sentences ☑
- ✓ Paragraph begins with a topic sentence ☑
- ✓ Would a parent or a 4th grader from another class understand the project by reading Q #1? ☑
- ✓ Explains about the budget clearly ☑
- ✓ Explains cost of one square foot for both special and regular rooms ☑
- ✓ Clearly explains what the scale of the house plan is (1 inch = 1 foot and 1 square inch = 1 square foot) ☑

Q #2:
- ✓ Explains clearly what AREA is ☑
- ✓ Explains what kind of units are used to measure area ☑
- ✓ Uses an example of how he or she figured out the area of one of their rooms ☑
- ✓ Uses complete sentences ☑
- ✓ Begins with a topic sentence ☑

Q #3:
- ✓ Uses numbers, words, and diagrams to explain how to use long multiplication to figure out area (like 16x12 or 18x9...) ☑
- ✓ Explains how to figure out a room's cost ☑
- ✓ Uses complete sentences and a topic sentence ☑

Q #4:
- ✓ Explains why he or she knows for sure that rooms are a reasonable area (for example, explains how furniture could fit, or how room compares to real room areas on our line plots...) ☑
- ✓ Uses complete sentences and a topic sentence ☑

Q #5:
- ✓ Gives the total area of the entire house in square feet ☑
- ✓ Gives the total house cost ☑
- ✓ Gives the amount remaining in budget (amount leftover + cost should = $100,000) ☑
- ✓ Gives total perimeter of house in feet (not square feet...) ☑

3-29-95

Designed House

The project is a house project. It is about building our own dream house. The total we could spend for our house is $100,000 and the land cost $20,000 too. The land is not free of course) so all together including the house and the land it cost $200,000. One square foot cost $75.00 for a regular room like a bedroom or a livingroom. but one square foot cost $150.00 for a special room like a swimming pool. 1 inch is one foot in the design.

Area is space covered in the whole thing. We use one square foot as one unit. My bedroom is 100 square feet. I did it by multiplying it. I count how many feet there are on one side and then I count how many feet there are on the top, then I multiply it together and I get the answer of how many square feet there are in the whole room. I do that with all the other rooms too.

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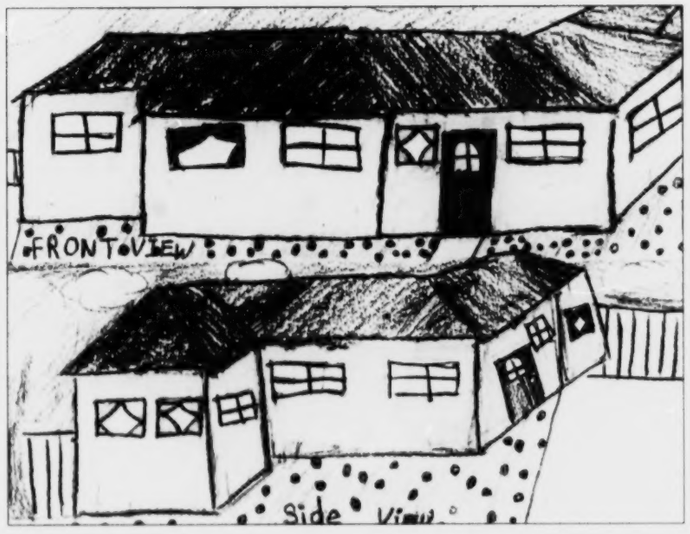
If one of my rooms is 13 ft x 14 ft, I first do 3x4=12 so I write the 2 and add the 10 to the 4x10 which is 40 but if I add a 10 to the 40, it'll be 50 so I write the 5 on the left side of 2, it's 52. Then I do 3x10 equals 30 I write the 3 under the 5 on top from 52. Then I do 10x10 and I write the 1 on the left side of 3. Then I add the 52 and 130 together and I got the answer of 182 square feet Here's what it looks like

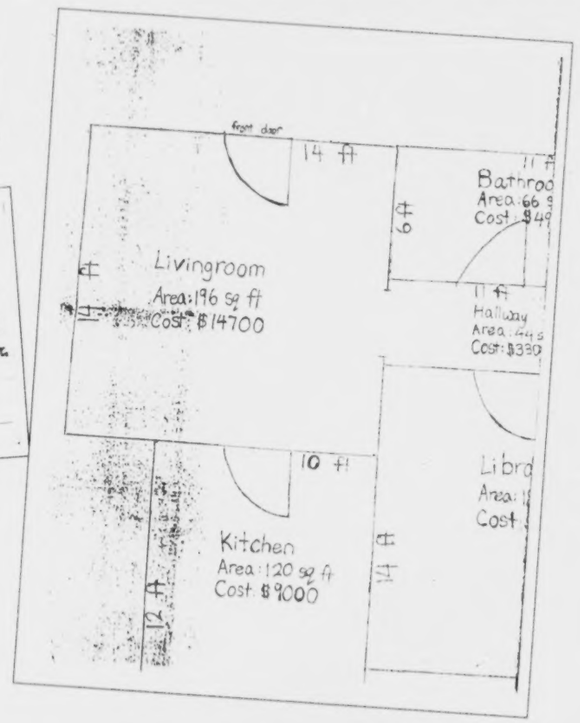
13
x4
52
+130
182

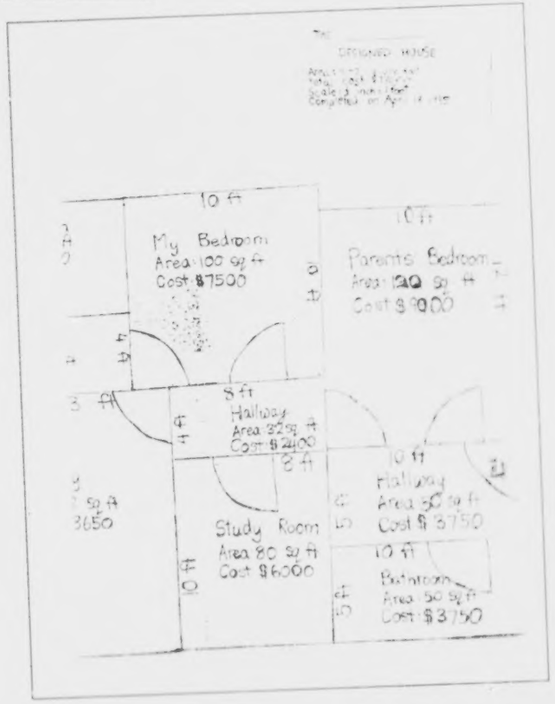
To find out the cost of a regular room, you multiply the total square feet to $75.00 because each square foot of a regular room is $75.00 so I'll do the total square foot of the room times $75.00 and if the room is a special room, you then use the total square fat of that room times $150.00 because that's how much one square foot cost for a special room.

I know all my rooms have a ressonable area, because I looked at the rooms chart that my class had made, those rooms are real rooms that the class had measured. Anyway I compared my rooms to the charts the class had made and see if it is too big or too small or just perfect, my rooms always turns out to be perfect. another way I could tell is by cutting out fake furnitures to put in the rooms and see if it fits.

My finished house have 1040 square feet, because I added w every room's total square feet and I got the answer. Then I check it with the other paper where I wrote down my exact square feet of my whole house and it's the same. Then I times 1040 with 75, because that's how much each square feet costs for a regular room. I used the calculator. I got the answer of $78000. That's how much money I spend I still have $22,000 left. But I'll also have that answer in the other sheet of paper. The whole perimeter of my house is 142 ft. I did it by counting the walls of my house and adding it together.







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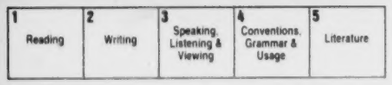
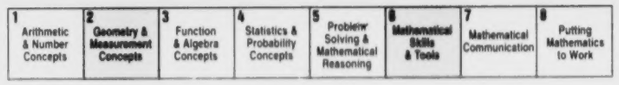
Work Sample & Commentary: *Constructing a Polyhedron*



English Language Arts


1 Arithmetic & Number Concepts
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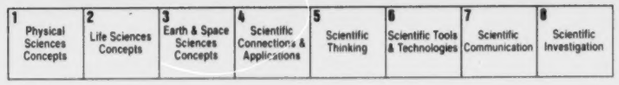
6 Mathematical Skills & Tools
7 Mathematical Communication
8 Putting Mathematics to Work

Mathematics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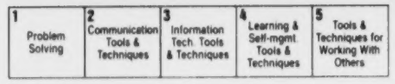
8 Scientific Investigation

Science


1 Problem Solving
2 Communication Tools & Techniques
3 Information Tech. Tools & Techniques
4 Learning & Self-mgmt Tools & Techniques
5 Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

The task

After looking at a poster that showed several polyhedra, students were asked to choose a polyhedron to construct. The main choices included the regular octahedron (a figure with eight equilateral triangles as faces), the regular icosahedron (a figure with 20 equilateral triangles as faces), and the cuboctahedron (a figure with six squares and eight triangles as faces). The snub icosadodecahedron was not offered as one of the choices. It was considered too complex for elementary students.

Students were expected to use nets of their chosen shape in order to determine how to build it. The net showed which polygons were needed and how they fit together. The students were then asked to make the polygons that were needed, by choosing a length for the sides and by using compasses to construct the polygons.

Students were expected to use the compasses somewhat informally to construct the triangles. They were instructed to decide on a length for the side of the triangle and draw one side. The students then put the stylus of the compass on one point at the end of the line segment that formed the first side of the triangle and extended the compass as long as the chosen length for the side of the triangle, since it was supposed to be equilateral (all three sides of equal length). The students then made an arc with the compass, put the stylus on the point at the other end of the first line, and drew an arc that crossed the first arc that was drawn. In this way, the intersection of the two arcs formed the third point of the triangle, and the other two sides could then be drawn.

This triangle then became the student's template for drawing the other triangles that were needed in the construction of the polyhedron. The triangle and the other polygons that the students constructed were converted into templates by extending the sides approximately three eighths of an inch and making additional flaps, as shown in the student sample. These templates were used to construct the three dimensional model. The templates were used to trace the polygons onto six ply railroad board. Rubber bands were then used to join the polygons together.

The student whose response is shown wanted specifically to make the snub icosadodecahedron. The teacher explained that there was no net available for it. The student decided to figure out the net, by looking at the shape as it appeared on the poster. The teacher also pointed out that this figure would take an extensive amount of time to construct, several hours beyond the amount of time the other students would be expected to spend. The student agreed to come in before and after school, as well as during lunch recesses, in order to construct it. Finally, the teacher pointed out that the pentagon, one of the kinds of faces that form the snub icosadodecahedron, was a difficult shape to construct. The student agreed to receive additional instruction about how to measure the angles using a protractor and how to construct a pentagon.

Circumstances of performance

Before beginning this project, students had been working with two dimensional geometry concepts, especially symmetry, congruence, quadrilaterals, triangles, circles, and diameter. They had constructed two dimensional "stained glass windows," according to specifications about the geometry required.

Other students completed their polyhedra in class. In order to finish this project, the student whose work is shown came to school a half hour early, stayed in at lunch recess, and stayed after school several times to, all voluntarily.

Mathematics required by the task

Students were asked to construct and work with polygons (two-dimensional or plane figures) and build a model of a polyhedron (a three-dimensional figure bounded by plane polygonal regions). Students had to be able to measure the length of sides of the polygons and use a compass to construct the shapes. Students were also asked to write about the construction and the polyhedron.

Mathematics evident in this student work

This student worked extensively with polygons and successfully constructed a highly complex polyhedron, the snub icosadodecahedron. (The snub icosadodecahedron is a polyhedron made of triangles and pentagons. Its name is derived from the dodecahedron, which is composed of pentagons, and the icosahedron, which is composed of equilateral triangles.) This student's work illustrates parts of the standard for Geometry and Measurement Concepts. In addition, the sample helps to illustrate what it means for an elementary student to go beyond the standard in some areas, e.g., the student constructs and works with pentagons, measuring the angles of the pentagon in degrees.

This work sample provides evidence for the quality of work expected for parts of the following Mathematics standards:

Standard 2, Geometry and Measurement Concepts—works with many types of figures and their properties, including triangles;

Standard 6, Mathematical Skills and Tools.

Geometry and Measurement Concepts

The student:

- **works with many types of figures and their properties, including triangles;**
- **extends and creates geometric patterns using concrete and pictorial models;**
- **uses basic ways of measuring the size of figures, including length;**
- **selects and uses appropriate units for measuring quantities, such as length.**

Completing the three dimensional model of a snub icosadodecahedron shows the depth of the student's working knowledge of these geometry and measurement concepts. The student response shows work with figures. The work shows how geometric patterns have been extended with models. The project involved using basic ways of measuring and selecting appropriate units of measurement.

The student response also illustrates work beyond the elementary standard. Specifically, the steps of constructing pentagons, even with teacher assistance, and the concept and construction of the snub icosadodecahedron are more than one would expect. The student's motivation to do what she wanted to do and her willingness to put in the time required to be successful allowed her to be successful.

Mathematical Skills and Tools

The student:

- **estimates numerically and spatially;**
- **measures length accurately;**
- **refers to geometric shapes and terms correctly with concrete objects, including triangle, side, face, vertex, point, and line;**
- **uses recall, mental computations, pencil and paper, measuring devices, mathematics texts, manipulatives, and advice from peers, as appropriate, to achieve solutions.**

The student shows a high degree of manual skill by completing such a complex model. Still, in the writing, some terms are referred to incorrectly, such as "vertex." The student apparently has a working understanding of the terms but lacks a clear definitional knowledge. The writing of "4 ½" is also incorrect in some places. Nevertheless the student's response illustrates work beyond the standard as well, because the student conveys knowledge about degrees, precise angles, pentagons, and icosadodecahedra.

Other comments

If this project were written up in a more systematic way, it would illustrate one example of a pure mathematics investigation, one of the projects described in the standard for Putting Mathematics to Work.

The student misspells several words in the written portion of the work. This was a class assignment and was not intended to be further edited for spelling or grammar. The focus of the assignment was the construction. The spelling and grammar errors are reasonable in first draft work, e.g., "notice" for "noticed" and "pentigon" for "pentagon."

Readers who build this figure will discover that there are actually 80 triangles, not 78, as the student reports.

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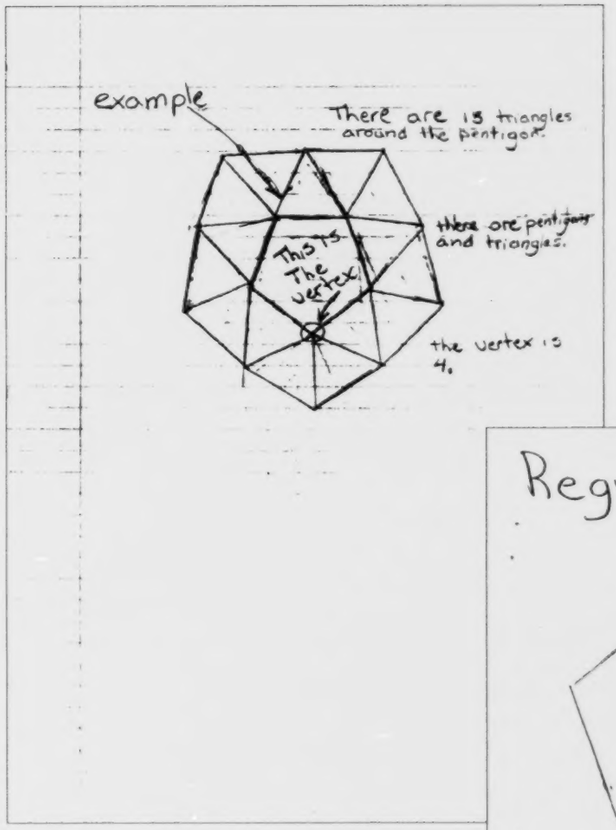
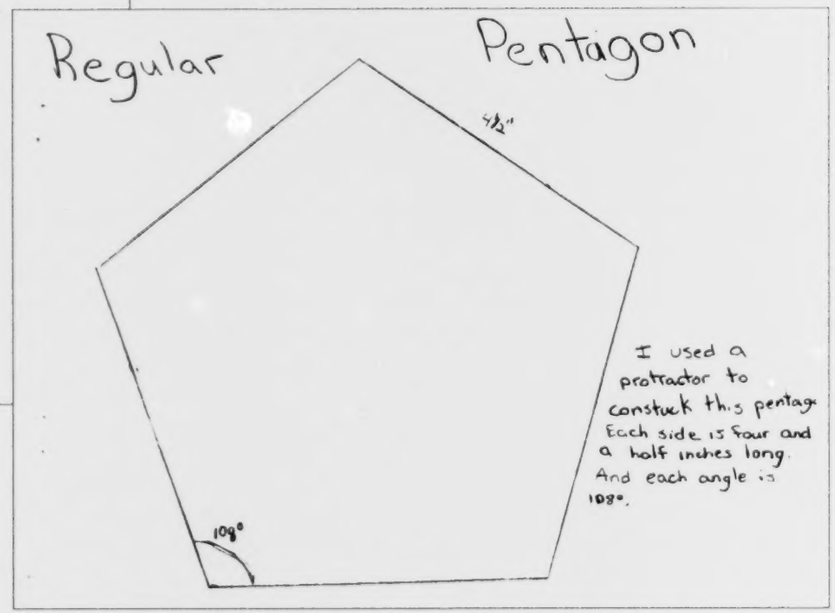
Frist thing I did was make the SNUB ICOSIDODECAHEDRON. Then When I was done making it I notice some stuff. One thing I notice was that the faces on mat snub icosidodecahedron were pentigons and triangles. And faces means sides. Then I notice that the vertex was 4. The vertex means the points that met together. An example is on the next page. Then I notice that all around the pentigon is triangles and that there are 12 that fit around a pentigon. Then I notice that a pentigon never touch another pentigon. And to make it you had to make 78 triangles and 12 pentigons to make the Snub Icosidodecahedron. But I notice some of that stuff I had to know before I started.




Regular
Pentagon
4½"
I used a protractor to construct this pentagon. Each side is four and a half inches long. And each angle is 108°.
108°

Teachers in Japan are expected "to help students understand fundamental solid figures, thereby enabling them to make a simple study of space."

Course of Study for Elementary Schools in Japan, p. 46.

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Work Sample & Commentary: *Constructing a Polyhedron* continued

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 **Geometry & Measurement Concepts**	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 **Mathematical Skills & Tools**	7 Mathematical Communication	8 Putting Mathematics to Work

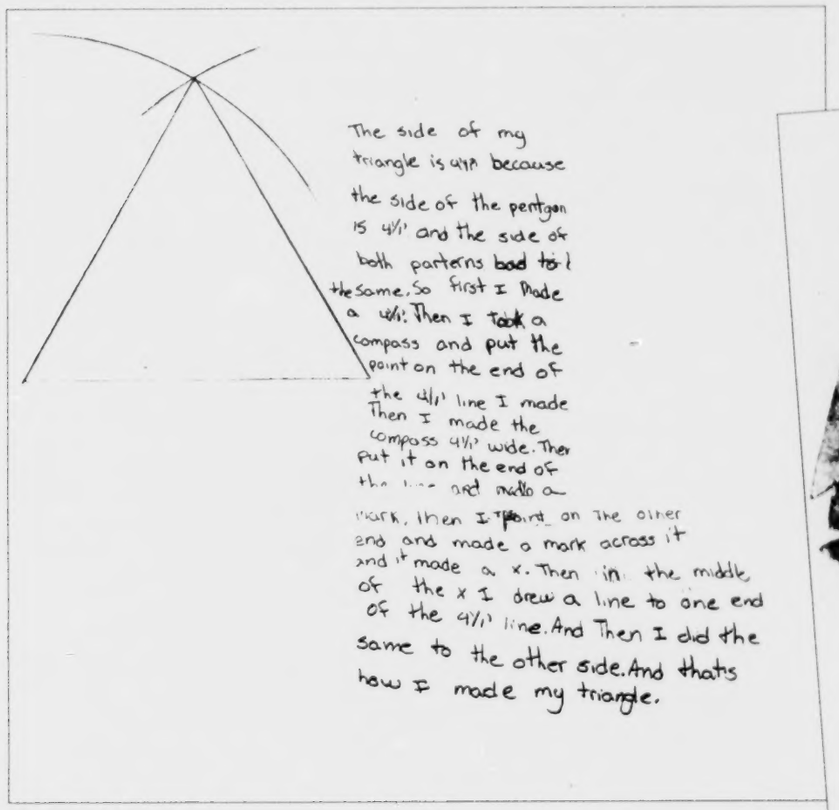
Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

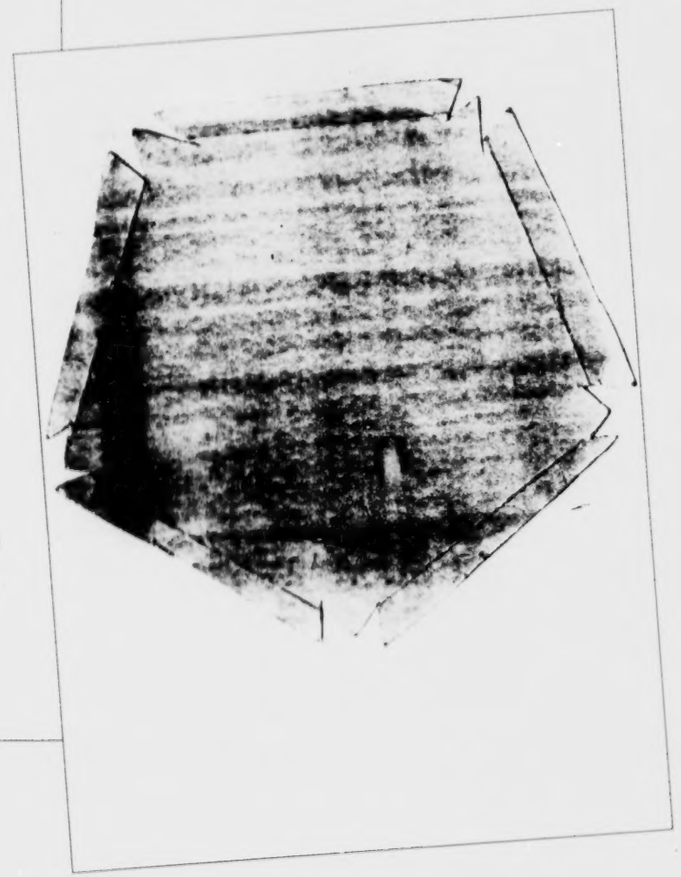
Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning



The side of my triangle is 4½' because the side of the pentgon is 4½' and the side of both parterns had to be the same. So first I made a 4½'. Then I took a compass and put the point on the end of the 4½' line I made Then I made the compass 4½' wide. Then put it on the end of the line and made a mark. Then I put it on the other end and made a mark across it and it made a x. Then in the middle of the x I drew a line to one end of the 4½' line. And Then I did the same to the other side. And thats how I made my triangle.



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Samples of student work that help explain "how good is good enough" for these standards can be found immediately following these pages.

To see how these performance descriptions compare with the expectations for middle school and high school, turn to pages 98-105.

The Science standards are founded upon both the American Association for the Advancement of Science's Project 2061 *Benchmarks for Scientific Literacy* and the National Research Council's *National Science Education Standards draft*. These documents, each of which runs to several hundred pages, contain detail that amplifies the meaning of the terms used here.

1. Physical Science Concepts

The student understands:

- **the observable properties of objects and materials;**
- **motions of objects, in particular, push and pull, sound;**
- **heat, light, electricity, and magnetism.**

Examples of performances that may demonstrate understanding include:

- sorting objects into two or more categories; changing the categories to include a new object; explaining the rule to another student;
- drawing pictures that show what happens when ice melts, water boils or evaporates, and steam condenses;
- describing the bouncing pattern of a basketball, comparing patterns of balls used in different sports;
- designing and making a musical instrument *(see the National Research Council draft)* and explaining how differences in form relate to differences in sound *(see also Applied Learning Standard 1)*.

2. Life Sciences Concepts

The student understands:

- **characteristics of organisms; that is, needs, environments that meet them; structures, especially senses; variation and behaviors, inherited and learned;**
- **life cycles, including birth, development, reproduction;**
- **organisms and environments, in particular, food chains, populations, effects on the environment;**
- **change over time, including fossil evidence.**

Examples of performances that may demonstrate understanding include:

- predicting how long a plant will live planted in moist soil in a closed glass jar located by a window; telling what additional information would be needed to make a better prediction *(see the National Research Council draft)*;
- making from observations a series of drawings that shows the life cycle of a plant or an animal;
- planning the supplies and equipment needed for a camping trip and explaining their purposes *(see also Mathematics Standard 8; Applied Learning Standard 1)*;
- participating in a 4-H animal care project; writing a report and presenting the animal at the county-wide fair.

3. Earth and Space Sciences Concepts

The student understands:

- **properties and uses of Earth materials, including rocks, soils, water, and gases;**
- **patterns, cycles, seasons, time, weather, and Earth motion;**
- **change over time, for example, erosion.**

Examples of performances that may demonstrate understanding include:

- identifying features of the school building that are related to the weather; explaining what would change inside the classroom if they were not present;
- keeping a record of the shape of the moon for several months; predicting what will happen in the next week;
- collecting information from a weather station and using the information to describe the changes from fall to winter *(see also Mathematics Standards 1 and 4; Applied Learning Standard 1)*;
- writing a story that tells what happens to a drop of water when it goes from a lake to a river.

4. Scientific Connections and Applications

The student understands:

- **big ideas and unifying concepts, for example, order, models, form, change, cause and effect;**
- **the designed world, in particular, agriculture and technology;**
- **health, especially nutrition, germs, toxic substances, safety;**
- **science as a human endeavor.**

Examples of performances that may demonstrate understanding include:

- determining which brand of paper towel is the best buy and writing an advertisement for it that highlights the findings of the experiment;
- explaining why people who have colds should wash their hands when preparing food;
- making recommendations to improve the selection of food in the vending machines near the school so that students will make healthier choices *(see also Mathematics Standard 8; Applied Learning Standard 1)*;
- building a solar cooker and determining what foods can be cooked safely with the temperatures achieved;
- interviewing a person who has a job that interests you; finding out how the person prepared for the job and how studying science played a role;
- earning the Webelos Engineer Badge (Boy Scouts of America) or the Brownie Building Art Try-It (Girl Scouts of America) and explaining the model that you built.

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5. Scientific Thinking

The student uses scientific reasoning strategies, scientific knowledge, and common sense to formulate questions about, understand, and explain a wide range of phenomena; that is, the student:

- **asks questions about objects, organisms, and events in the world;**
- **seeks information from reliable sources, including scientific knowledge, observation, and trying things out;**
- **uses evidence to construct an explanation; recognizes a fair test;**
- **recognizes others' points of view; checks his or her own and others' explanations against experiences, observations, and knowledge;**
- **identifies problems, proposes and implements solutions, evaluates products or designs;**
- **works individually and in teams to collect and share information and ideas.**

Examples of scientific thinking include:

- ▲ using the data from one investigation to generate a prediction for a new investigation;
- ▲ determining which brand of paper towel is the best buy and writing an advertisement for it that highlights the findings of the experiment;
- ▲ analyzing a toothpaste advertisement and indicating what evidence would be needed to back up its claims.

6. Scientific Tools and Technologies

The student uses tools and technologies to collect and analyze data; that is, the student:

- **uses simple technology and tools to gather data and extend the senses, for example, rulers, balances, thermometers, watches, magnifiers, and microscopes;**
- **collects and analyzes data, using concepts and skills in Mathematics Standard 4, Statistics and Probability Concepts;**
- **acquires information from print and non-print sources.**

Examples of using scientific tools and technologies include:

- ▲ collecting information from a weather station and using the information to describe the changes from fall to winter *(see also Mathematics Standards 1 and 4; Applied Learning Standard 1)*;
- ▲ conducting a survey of students' energy use at home and at school;
- ▲ using telecommunications to compare data on similar investigations with students in another school;
- ▲ using electronic databases to find out about the nutritional value of food available in the cafeteria *(see also Applied Learning Standard 1)*.

7. Scientific Communication

The student communicates clearly and effectively about the natural world; that is, the student:

- **represents data and results in more than one way, for example, numbers, drawings, words, tables;**
- **uses facts to support conclusions;**
- **critiques written and oral explanations;**
- **writes instructions that others can follow;**
- **communicates in a form suited to the purpose and the audience; uses data to resolve disagreements.**

Examples of scientific communication include:

- ▲ making a series of drawings that shows the life cycle of a plant or an animal from observations;
- ▲ deciding which brand of paper towel is the best buy and writing an advertisement for it that highlights the findings of the experiment;
- ▲ preparing a report, with graphs, charts, and diagrams, on the optimal number and placement of recycling containers, based on trash disposal data from the classroom and the entire school *(see also Mathematics Standard 7; Applied Learning Standard 1)*.

8. Scientific Investigation

The student completes projects drawn from the following kinds of investigation, including at least one full investigation each year and, over the course of elementary school, investigations representing all four kinds.

- **Experiment; that is, conducting a fair test;**
- **Systematic observation;**
- **Design;**
- **Use of print and electronic (that is, video or computer) information.**

A single project may draw on more than one kind of investigation.

A full investigation includes:

- **questions that can be studied using the resources available;**
- **procedures that are safe, humane, and ethical; respect privacy and property rights;**
- **data that have been collected and recorded *(see also Science Standard 6)* in ways that others can verify, and analyzed using skills expected at this grade level *(see also Mathematics Standard 4)*;**
- **data and results that have been represented *(see also Science Standard 7)* in ways that fit the context;**
- **recommendations, decisions, and conclusions based on evidence;**
- **acknowledgment of references and contributions of others;**
- **results that are communicated appropriately to audiences;**
- **reflection and defense of conclusions and recommendations from other sources and peer review.**

Examples of scientific investigations include:

- ▲ making a series of drawings that shows the life cycle of a plant or an animal from observations;
- ▲ designing and build a musical instrument *(see the National Research Council draft)* and explaining how differences in form relate to the differences in sound *(see also Applied Learning Standard 1)*;
- ▲ designing, making, and flying kites; modifying the kites so they fly higher, maneuver more easily, or achieve some other goal;
- ▲ with a partner, selecting an endangered plant or animal in the local area; collecting information from reference books, magazines, video; debating whether the plant or animal should be saved or allowed to disappear, and why;
- ▲ investigating why different plants live in the cracks of the sidewalk in different areas around the school.

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Work Sample & Commentary: *Sandbox*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 **Earth & Space Sciences Concepts**	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 62-63.

The standards for elementary school are set at a level of performance approximately equivalent to the end of fourth grade and for middle school at the end of eighth grade. It is expected that some students might achieve these levels earlier and others later than these grades. It is the expected quality of work rather than the age or grade of the student that we are attempting to illustrate. We have used five samples of student work done when the students were in the sixth grade. This sample and two others illustrate the elementary standard; responses to two different tasks from the same sixth grade test are used to illustrate the middle school standard.

In France, children in primary school are expected to learn about "states of matter (solid, liquid, gas) and their transformations; the properties of air and water."

Les cycles `a l'école primaire, p. 110.

Science required by the task

In an on-demand state assessment, students in a sixth grade self-contained classroom were given a drawing showing a sandbox covered with a plastic sheet held down with stones. The text explains that the sand was wet from rain, then covered with plastic overnight to keep the sand from becoming wetter. When the sandbox was examined the next morning the top of the plastic cover was dry, but the underside had droplets of water. The students were asked to give two different reasons for the moisture on the bottom of the plastic cover. The task was completed in one class period with no peer assistance and there was no opportunity for revision.

The task asks for evidence of understanding evaporation and condensation, parts of:

Standard 3, Earth and Space Sciences Concepts—cycles (the water cycle).

Science evident in this student work

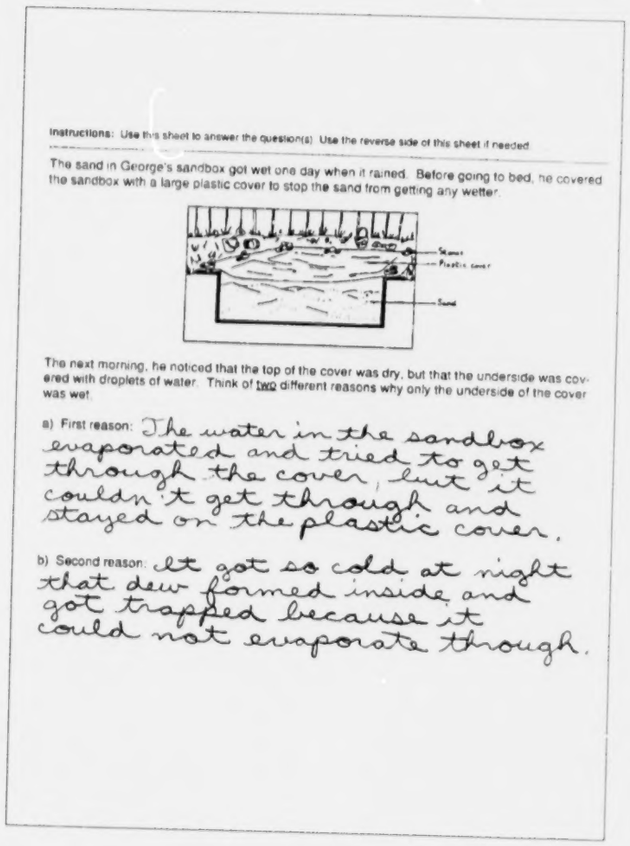
The work provides evidence for an understanding of evaporation and condensation.

Earth and Space Sciences Concepts

The task asks for two different reasons why the underside of the cover was wet. The first reason, that the water evaporated and "stayed on the plastic cover," would be more complete if the student had clearly stated that the water vapor returned to liquid form. The second reason, that water already in vapor form under the cover had formed dew, is also correct but incomplete, as it does not clearly indicate a vapor-to-liquid change nor explain why dew did not form on the outside of the cover as well. That there was more water vapor in the air under the cover than outside of it is something that the reader has to supply. This task was designed for sixth grade students. More complete answers would be expected from students at that level. In the fourth grade level illustrated here, the work includes enough elements of evaporation and condensation to provide evidence of reasonable understanding. Note that the word "condense" is not present in the response, but the relationship between the air temperature and the amount of moisture that it can hold is evident in part b. Discussion of this relationship provides more evidence of understanding than the use of the word alone would provide. The simplicity and clarity of the language should not be discounted. In fact, it reveals understanding of a complex concept.

Going beyond

Understanding evaporation and condensation are important parts of understanding the water cycle, which is itself an important component of understanding weather. Weather is a major focus of the standard for Earth and Space Sciences Concepts at the elementary school level, but it is too narrow a focus for assessing the standard as a whole. Conceptual understanding of other aspects of weather and properties of Earth materials would need to be demonstrated.



Instructions: Use this sheet to answer the question(s). Use the reverse side of this sheet if needed.

The sand in George's sandbox got wet one day when it rained. Before going to bed, he covered the sandbox with a large plastic cover to stop the sand from getting any wetter.

The next morning, he noticed that the top of the cover was dry, but that the underside was covered with droplets of water. Think of <u>two</u> different reasons why only the underside of the cover was wet.

a) First reason: The water in the sandbox evaporated and tried to get through the cover, but it couldn't get through and stayed on the plastic cover.

b) Second reason: It got so cold at night that dew formed inside and got trapped because it could not evaporate through.

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Work Sample & Commentary: *The Disappearing Puddle*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	Statistics & Probability Concepts	Problem Solving & Mathematical Reasoning	Mathematical Skills & Tools	Mathematical Communication	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	**Earth & Space Sciences Concepts**	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

Science required by the task

Students in a self-contained fourth grade classroom were asked through an on-demand task to explain why water in a puddle will eventually disappear.

The task requires explanations that illustrate the following part of:

Standard 3, Earth and Space Sciences Concepts—cycles, weather.

The first sample is the work of a student responding to that on-demand task. Students worked alone with no peer or teacher feedback for 55 minutes on items unrelated to the current unit of study. Students were allowed to use a combination of formats—writing, drawing, word-processing—to produce their responses.

The second sample is a revision by the same student, who responded to the following instruction: "Proofread your work so that it would be clear to any reader and correct anything you think needs correcting."

Science evident in this student work

The first draft of the work shows a preliminary understanding of the water cycle, one of the parts of the standard for Earth and Space Sciences Concepts. The elaborations in the second draft go considerably farther than the task required and provide evidence of a preliminary understanding of weather. Weather is a related part of the standard.

Some spelling errors are corrected in the second draft, e.g., "precipitation" is corrected but "amont" for "amount," "hale" for "hail," and "anymore" for "any more" are not. Additionally, the second draft is more detailed. While the text is somewhat improved and the diagrams are neater, the second draft does not communicate more clearly or accurately than the first draft. As a result, the second draft does not offer evidence for Standard 7, Scientific Communication.

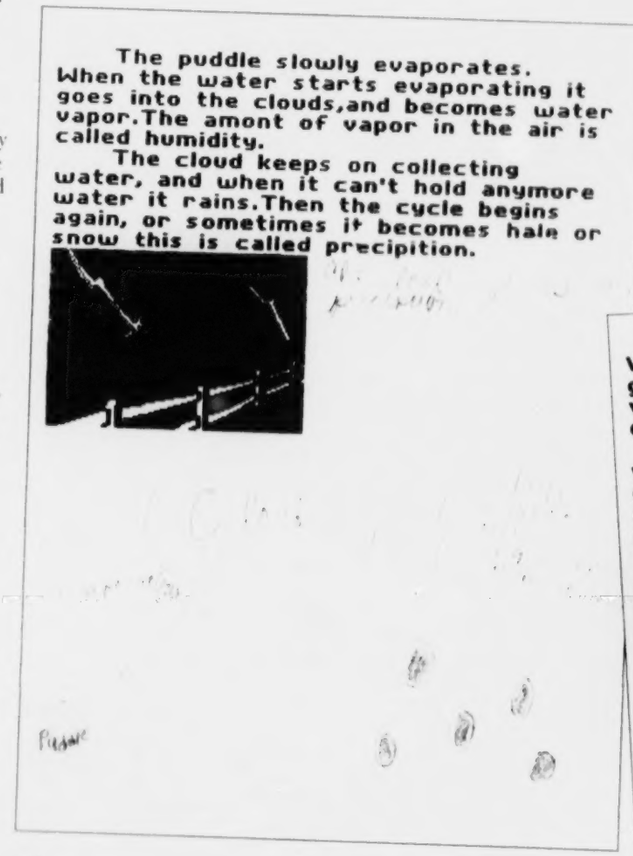
Earth and Space Sciences Concepts

These work samples, particularly the diagrams, illustrate the quality of work expected for an elementary school understanding of the basic transformations in the water cycle: liquid water evaporates to become water vapor, then condenses, then precipitates as rain or snow.

References to water "vapor" are not consistent. The expression is used correctly in the first paragraph. It is missing in the second paragraph. The clause "The cloud keeps on collecting water" should read "The cloud keeps on collecting water vapor." The inaccurate idea that a cloud is like a sponge is common at this level. While these responses do not use the sponge metaphor, the omission of the word "vapor" in the second paragraph and the statement that the "Cloud collects a lot of rain from many puddles" provide evidence of this misconception. However, the statement that "The amount of vapor in the air is called humidity" shows a clear understanding of the meaning of vapor.

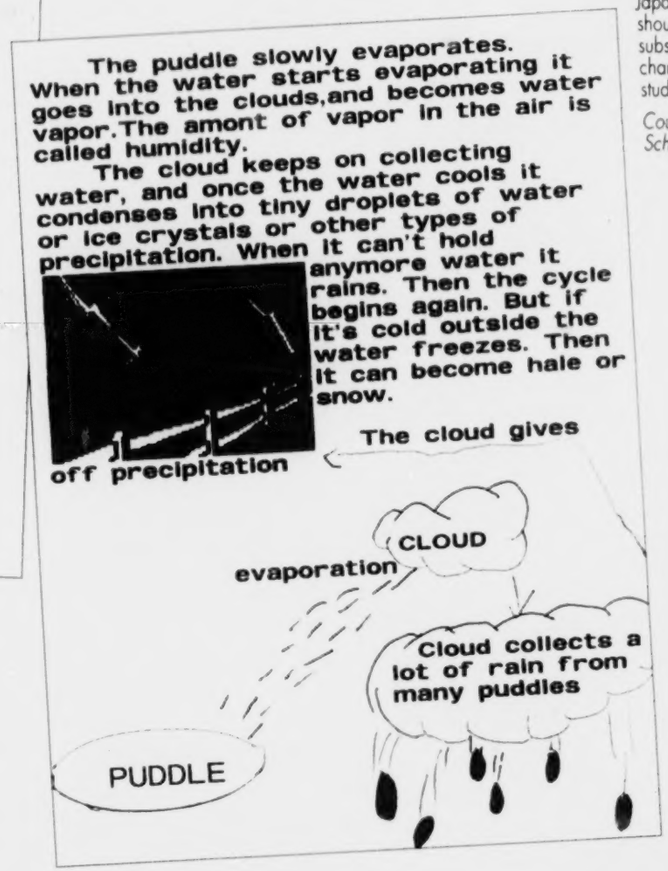
Going beyond

These samples show the difficulty of assessing preliminary understanding of complex and abstract ideas evident in the work of elementary students. A generous reader can point to the correct elements and assert that the student has a sophisticated understanding for an elementary student; a strict reader can point to the incorrect elements and assert the reverse. The task is to evaluate the evidence rather than make inferences about the student. The idea that water evaporates and causes humidity is a good step toward an understanding of evaporation. The evidence here shows beginning understanding of the water cycle, upon which further learning can build. It is evidence for the quality of work expected at the elementary level.



The puddle slowly evaporates. When the water starts evaporating it goes into the clouds,and becomes water vapor.The amont of vapor in the air is called humidity.

The cloud keeps on collecting water, and when it can't hold anymore water it rains.Then the cycle begins again, or sometimes it becomes hale or snow this is called precipition.



The puddle slowly evaporates. When the water starts evaporating it goes into the clouds,and becomes water vapor.The amont of vapor in the air is called humidity.

The cloud keeps on collecting water, and once the water cools it condenses into tiny droplets of water or ice crystals or other types of precipitation. When it can't hold anymore water it rains. Then the cycle begins again. But if it's cold outside the water freezes. Then it can become hale or snow.

The cloud gives off precipitation

CLOUD

evaporation

Cloud collects a lot of rain from many puddles

PUDDLE

The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 62-63.

Japanese elementary school students should "understand the properties of substances and the regularity in their changes and cultivate an attitude to study them actively."

Course of Study for Elementary Schools in Japan, pp. 63-64.

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Work Sample & Commentary: *Drop of Water*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 62-63.

Science required by the task

Students were asked to write a story about a drop of water that goes through the water cycle. This followed a two week unit on weather, including the water cycle.

The task draws on the following parts of the Science standards:

Standard 1, Physical Sciences Concepts—observable properties of objects and materials (phases of matter);

Standard 3, Earth and Space Sciences Concepts—properties and uses of Earth materials (water and gases); cycles (the water cycle).

Science evident in this student work

This work shows a deep level of conceptual understanding in physical sciences for an elementary student. By using the first person voice, the work sample represents abstract concepts in the water cycle, e.g., the spacing of molecules, in terms an elementary student would understand. Conceptual understanding of the water cycle is evident in the details of the journey from a lake in Nebraska to the Mississippi River and in the statement "The End, not really."

Physical Sciences Concepts

This work provides evidence for understanding of "observable properties of objects and materials" (phases of matter). Deep understanding is shown in the representation of relationships among phase, temperature, and volume. For example, "I feel bigger. That's because I am a gas. It happens every time I get hot. When I get cold I get smaller. They call me a solid."

Earth and Space Sciences Concepts

This work also provides evidence for understanding of "properties and uses of Earth materials" (water and gases) and "cycles" (the water cycle). Several key steps are included:

- the important role of the Sun, "The sun is going to take me for a ride today";
- the upward movement of water vapor, "I am climbing really fast";
- the transformation during condensation, "I am getting smaller...it's getting really crowded";
- the role of dust, "I think I will hang on to this dust guy";
- precipitation, runoff, and evaporation again.

The addition of the Physical Sciences Concepts involved in evaporation and condensation makes this a more powerful explanation of the water cycle than appears in the work sample titled "The Disappearing Puddle."

Going beyond

This work is a clear illustration of the quality of work expected for Earth and Space Sciences Concepts. To meet the standard, however, it would need to be accompanied by work of comparable quality that relates the water cycle to weather and seasons.

My Big Trip
by Jason

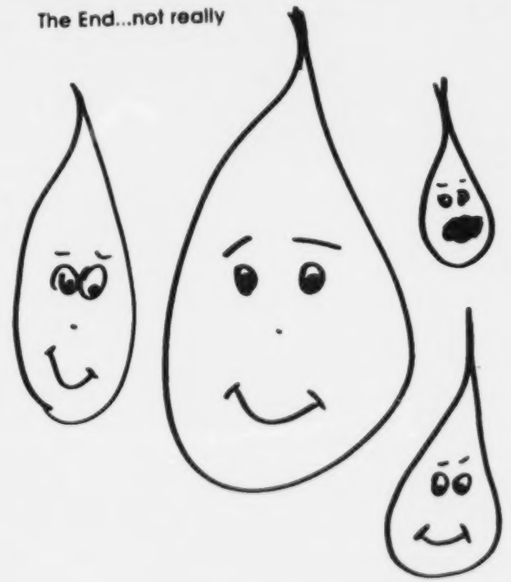
Good morning, I am Mr. H. Tuoh. I just woke up and the sun is coming up. I have been swimming with my friends in a nice lake in Nebraska. Since I am on top of this pile of sleeping friends the sun is going to take me for a ride today.

Wow, that was fast. I am climbing really fast. I feel bigger. That's because I am a gas . It happens every time I get hot. When I get cold I get smaller. They call me a solid. Being solid gives me a headache. This is better than World's of fun! There is a big cloud ahead and we are slowing down. I am getting smaller now because my pants fit better. But, it's getting really crowded!!! I can hardly move. Who let in the ugly dust family? I think I will hang on to this dust guy so I can rest up. Hey, everybody is coppying my idea and we are getting heavy. Oh Noooooooooooooooo we are falling!!! But that's OK because I was getting really cold.

What a trip. I am almost back to the lake. Wait, where is the lake. This looks like a big river . I don't think I am going to hit the river. Oh nooooooooo .I better put on my crash helmet and prepare for a land landing. OUCH! That hurt. But, at least I am down. hey, we are moving again. These dirt and rock hurt. Do they have to come along on MY trip?

Wow, I am in the Mississipi river! There are lots of us and mud and rocks and stuff. I feel kind of dirty. I wish I could go up to sit in the clouds a while. I will just sit back and float a while. Oh, here comes the sun. Here I go again. I wonder where I will end up this time.

The End...not really



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1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	Statistics & Probability Concepts	Problem Solving & Mathematical Reasoning	Mathematical Skills & Tools	Mathematical Communication	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	Scientific Thinking	Scientific Tools & Technologies	Scientific Communication	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

Science required by the task

Students were instructed to complete a laboratory activity in which they adjusted the mass and/or the volume of an object so that the object would not float on top of water or sink…it would "flink."

The task calls for the student first to explore the range of available floating and sinking objects. In order to engage the task, it is necessary to combine floating and sinking objects to construct one of the correct density. The sorting and classification of objects necessary to accomplish this activity requires understanding part of:

Standard 1, Physical Sciences Concepts—observable properties of objects and materials.

Science evident in this student work

In engaging this task, the student performed a simple experiment, accomplished by trial and error, in which an object became neutrally buoyant ("flinked"). The part of the work which explains why an object became neutrally buoyant ("flinked") is evidence for an elementary understanding of observable properties of objects and materials: "to make something flink, the mass and the volume had to equal one." The additional explanation, that "some things absorbe [sic] water and that gives it more mass," shows understanding beyond the elementary level and leads toward a middle school understanding of density.

Physical Sciences Concepts

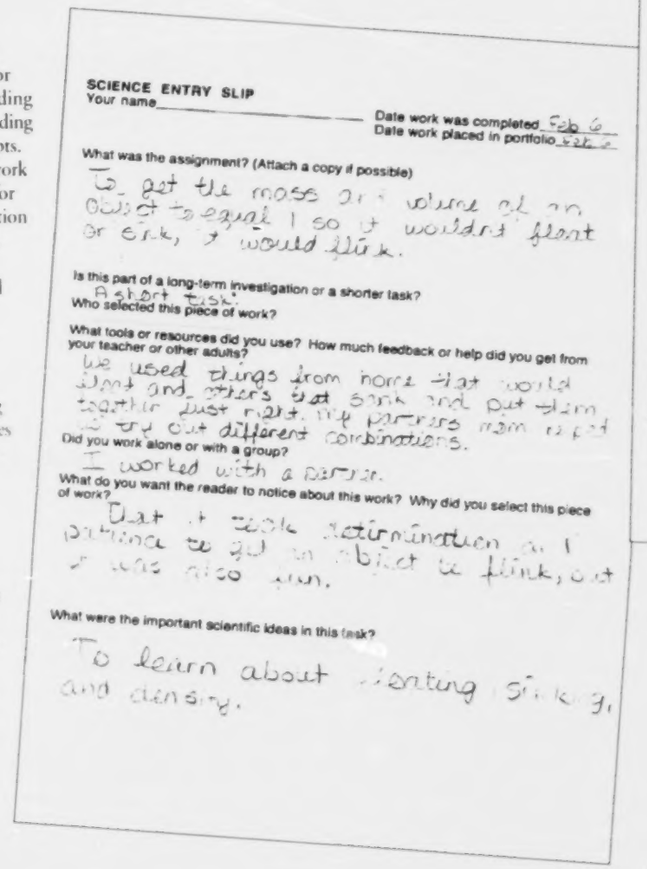
This work sample illustrates elementary school level conceptual understanding of the observable and measurable property of density. Sufficient evidence of understanding of density is represented by the statement: "to make something flink, the mass and the volume had to equal one." This kind of statement is insufficient for a middle school explanation of density, which expects the student to discuss density in terms of ratio. A comparable middle school level statement would be: "to make something flink, the ratio of the mass and the volume had to equal one"; or "to make something flink, the mass divided by the volume had to equal one." Further, and although this is perhaps taken for granted, an adequate middle school response would make explicit the density of water, which equals one.

The explanation, wherein things that absorb water increase in mass, is clear evidence for an awareness of the connection between mass and floating or sinking. The work shows that the final product was constructed by combining "some floating things and some sinking things." This shows that the objects had been sorted into different classifications based upon an observable characteristic (floating or sinking).

Going beyond

This sample would be appropriate to include in a portfolio exhibit for Conceptual Understanding as evidence of understanding physical sciences concepts. Additional samples of work that provide evidence for more complex classification skills would be helpful. For a portfolio exhibit that meets the standard for Physical Sciences Concepts, work of comparable quality would be expected, showing understanding of other physical sciences concepts, such as basic motions of objects, temperature changes, electricity and magnetism.

This work sample is an unrevised laboratory report. There are three spelling errors ("prossess", "absorbe", and "detirmination") and a missing apostrophe ("my partners mom").



SCIENCE ENTRY SLIP

Your name _____ Date work was completed Feb 6
Date work placed in portfolio Feb 8

What was the assignment? (Attach a copy if possible)

To get the mass and volume of an object to equal 1 so it wouldn't float or sink, it would flink.

Is this part of a long-term investigation or a shorter task?
A short task.
Who selected this piece of work?

What tools or resources did you use? How much feedback or help did you get from your teacher or other adults?

We used things from home that would float and others that sink and put them together just right. My partners mom helped us try out different combinations.

Did you work alone or with a group?

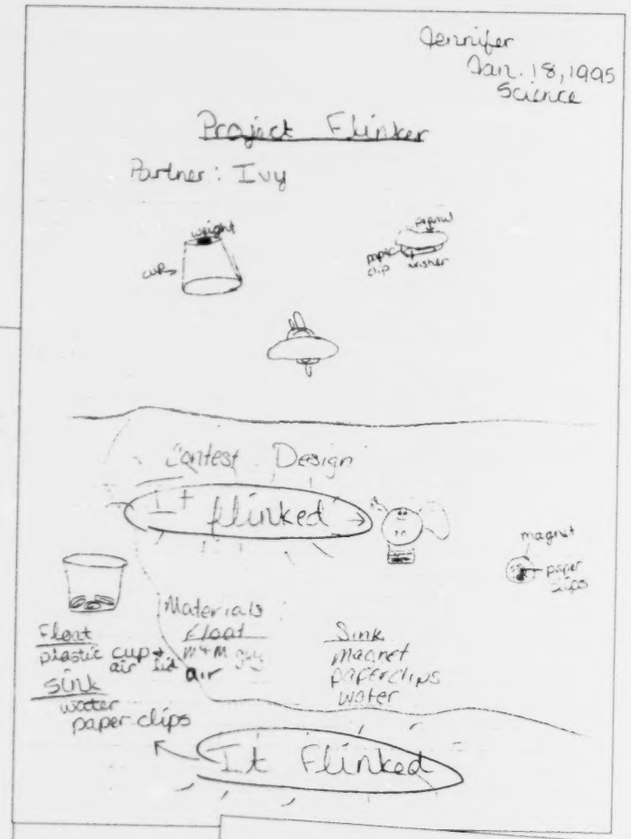
I worked with a partner.

What do you want the reader to notice about this work? Why did you select this piece of work?

That it took determination and patience to get an object to flink, but it was also fun.

What were the important scientific ideas in this task?

To learn about floating sinking and density.



The flinker lab was an enjoyable way to learn about why things float and sink. To make something flink, the mass and the volume had to equal one. And to do this, you had to use a prossess of trial and error to get them to equal 1. One reason we had trouble is that some things absorbe water and that gives it more mass. But we finally made a creative design that flinked with some floating things and some sinking things.

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The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 62-63.

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Work Sample & Commentary: *The Growing Tree*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 **Life Sciences Concepts**	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 **Scientific Communication**	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 62-63.

French students are expected to know about "plant life: the need for water and light; plant growth and development."

Les cycles à l'école primaire, p. 111.

Science required by the task

Elementary students were asked to explain why a tree gained 250 kg. in a 20 year span. Two samples of student work are provided here, the first from a fourth grader and the second from a sixth grader.

Both students completed their work in an on-demand test setting, with the task unrelated to the unit of study and without any teacher or peer assistance. The responses are unrevised, first draft work produced in 20 minutes. They provide evidence for understanding of:

Standard 2, Life Sciences Concepts—characteristics of organisms (needs, environments that meet them).

Science evident in this student work

The first sample provides evidence for understanding Life Sciences Concepts, as required by the task. This sample was produced by a student in a special education reading program. Despite the punctuation, capitalization, and spelling errors, this sample effectively uses a drawing to strengthen the written response.

The student's response therefore additionally provides evidence for:

Standard 7, Scientific Communication—represents data and results in more than one way, for example, numbers, drawings, words, tables.

The second response also provides evidence for understanding Life Sciences Concepts, but relies on clearly written prose.

Life Sciences Concepts

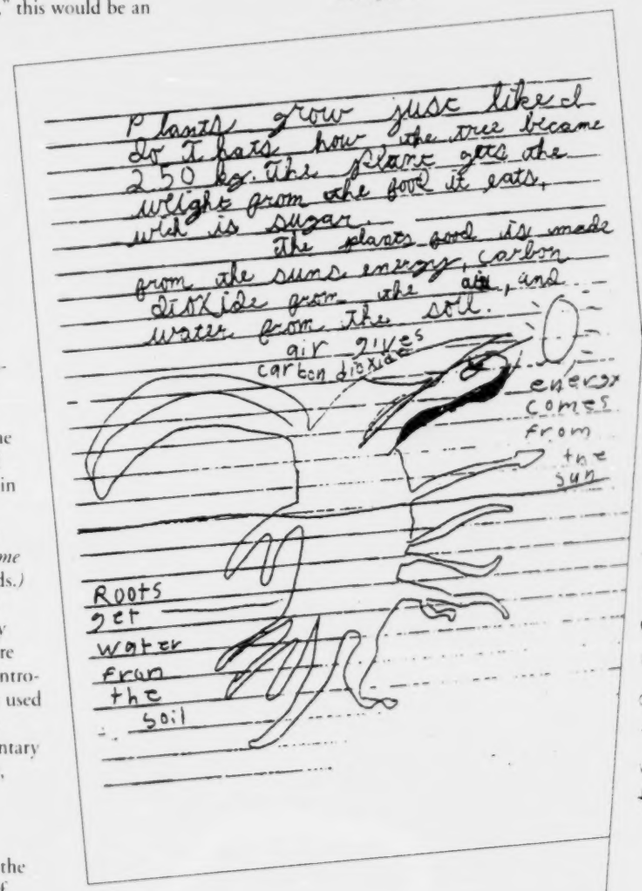
The first sample includes most of the components of photosynthesis: energy from the sun, carbon dioxide from the air, and water from the soil, though the minerals are omitted. The statement that "Plants grow just like I do" shows an understanding of the comparable ways that plants and animals grow. This understanding will become more refined in two ways: first, by including the mechanism of adding cells, which is not mentioned in this work; and second, by clarifying the differences between plant and animal growth, e.g., that plants can and do make their own food while animals cannot. On the latter point, the idea that plants "eat" sugar is a common statement at the elementary level. The significance of the statement depends on what is meant by "eat." If, for example, the student means "take into their cells and use for growth and other life processes," this would be an accurate understanding.

The statement in the second paragraph, "The plant's food is made from the sun's energy, carbon dioxide from the air, and water from the soil," shows a high level of conceptualization for an elementary student.

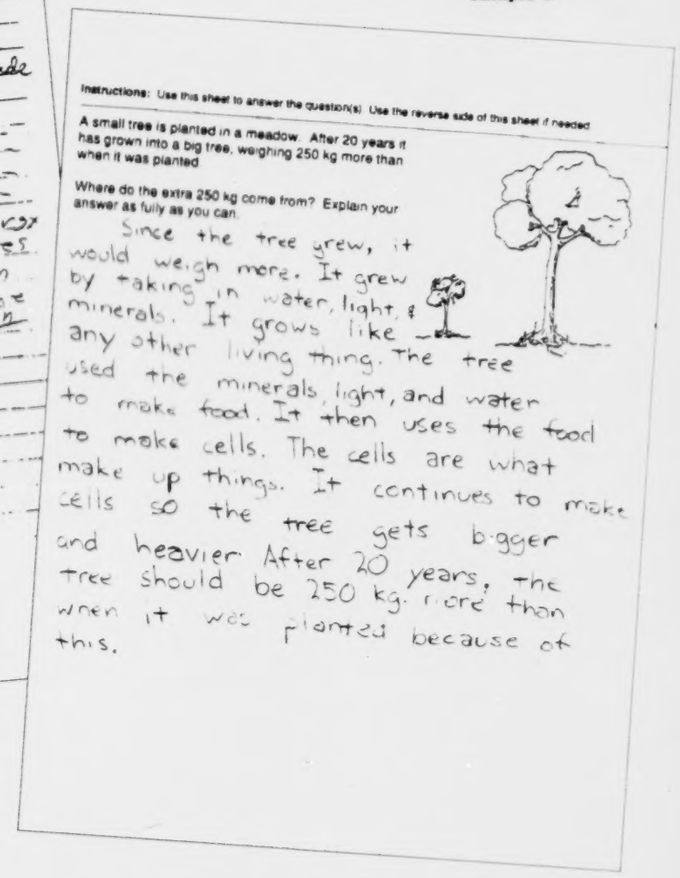
The second sample, produced by a sixth grade student, also mentions three out of four important ingredients of photosynthesis (minerals, water, and light, but not carbon dioxide). Mentioning the necessity for the presence of carbon dioxide and chlorophyll would be required in a middle school response. (*See also the high school work sample entitled "Photosynthesis" in Volume 3 of these* Performance Standards.) The comparison of fourth and sixth grade work represented by the two responses presented here shows the sixth grade student introducing a new idea: that food is used to make cells. This elaboration shows progress from the elementary level to the middle school level, where structure and function are introduced.

A balance is expected between the evidence for the mechanisms of growth (presented in the two work samples discussed above) and evidence for understanding life cycles of organisms and relationships among them.

Sample 1


Plants grow just like I do. It says how the tree became 250 kg. The plant gets the weight from the food it eats, and is sugar.
the plants food is made from the suns energy, carbon dioxide from the air, and water from the soil.
air gives carbon dioxide
energy comes from the sun
Roots get water from the soil

Sample 2


Instructions: Use this sheet to answer the question(s). Use the reverse side of this sheet if needed
A small tree is planted in a meadow. After 20 years it has grown into a big tree, weighing 250 kg more than when it was planted
Where do the extra 250 kg come from? Explain your answer as fully as you can.
Since the tree grew, it would weigh more. It grew by taking in water, light, & minerals. It grows like any other living thing. The tree used the minerals, light, and water to make food. It then uses the food to make cells. The cells are what make up things. It continues to make cells so the tree gets bigger and heavier. After 20 years, the tree should be 250 kg. more than when it was planted because of this.

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Work Sample & Commentary: *Aquarium*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	**2 Life Sciences Concepts**	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

Science required by the task

In an on-demand state assessment, students in a sixth grade self-contained classroom were given a drawing of an aquarium with the following labeled items: light, thermometer, castle, rock, snail, and plant. The task asked students to explain which of the six items are important to use with or in an aquarium and to explain why. The task was completed in one class period with no peer assistance, and there was no opportunity for revision.

The task asked students to consider the importance of using items commonly found in or with an aquarium. It relates to:
Standard 2, Life Sciences Concepts—characteristics of organisms (needs, environments that meet them).

Science evident in this student work

In this student's response, the contribution of each of six items is addressed correctly and systematically, demonstrating an understanding of each item's role in the environment of the fish, and providing evidence for understanding characteristics of organisms and their environment.

Life Science Concepts

The response provides evidence of a high degree of conceptual understanding. It correctly identifies the role each labeled item plays in the environment and connects the item to the needs of the fish. For a fairly straightforward question, the response provides elaborations that show this depth of understanding. For example, the claim that the plant supplies oxygen and provides shelter is a very complete response for the elementary school level, since specifying either oxygen supply or shelter would have been adequate. Additionally, the comment that the thermometer reading must neither be too hot nor too cold shows a good degree of accuracy for this level, as does the description of the role of the snail in cleaning the tank by eating the decomposing material. Objects such as the rock and the castle are used in aquaria for decoration as well as protection. From the drawing, one could argue that the fish are large enough not to need protection and that these objects are ornamental. That would also be a correct response. As the student claims, the light does provide warmth. It also helps the plant to grow. Although one might expect the student to assume that the room's ambient light would suffice for plant growth, this is a refinement appropriate for students at the middle school level, not an elementary student producing a comprehensive response on a timed test. The systematic treatment of all of the items is also a strength at the elementary level.

Going beyond

Students who have an aquarium at home or in their classrooms would have an advantage in completing this task, but recognizing the needs of organisms and their relationship to the environment should be within the experience of all students. At the middle school level, it would be expected that students could provide a similar analysis for an environment with which they have less first hand experience.

This short on-demand sample provides evidence for understanding a central idea of Life Sciences Concepts: "characteristics of organisms." It is not sufficient evidence for all aspects of the standard. To meet the standard, it would need to be accompanied by work that demonstrates comparable understanding of life cycles.

This on-demand work was not revised. It contains spelling errors in words that are sophisticated for students, e.g., "oxegen" for "oxygen" and "neteher" for "neither."

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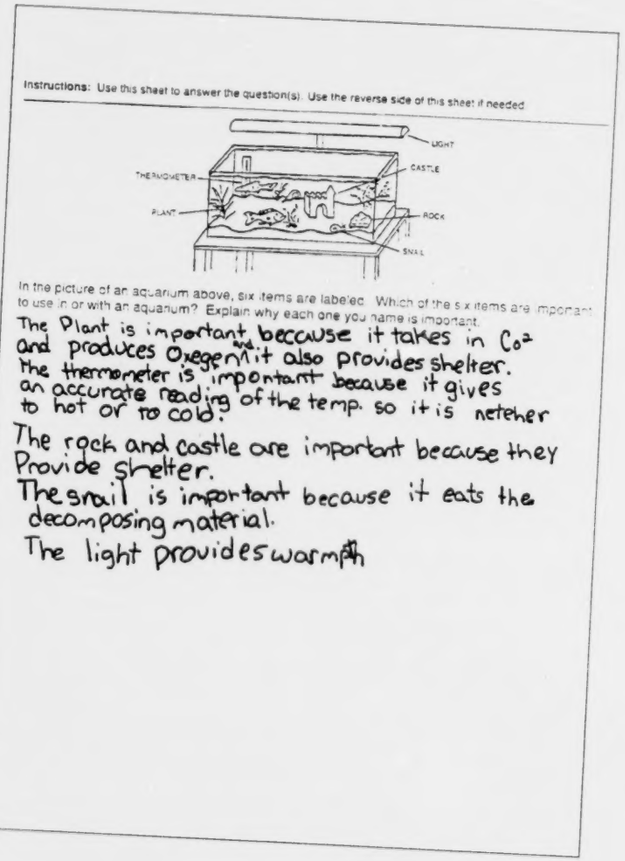

Instructions: Use this sheet to answer the question(s). Use the reverse side of this sheet if needed.

In the picture of an aquarium above, six items are labeled. Which of the six items are important to use in or with an aquarium? Explain why each one you name is important.

The Plant is important because it takes in Co^2 and produces Oxegen it also provides shelter.
The thermometer is important because it gives an accurate reading of the temp. so it is neteher to hot or to cold.
The rock and castle are important because they Provide shelter.
The snail is important because it eats the decomposing material.
The light provides warmth

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Work Sample & Commentary: *Yeast Growth*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 **Life Sciences Concepts**	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 **Scientific Thinking**	6 **Scientific Tools & Technologies**	7 Scientific Communication	8 **Scientific Investigation**

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 62-63.

This piece of work and the one that follows come from a project where students share their work on the Internet. The General Accounting Office recently reported that more than half of 10,000 schools surveyed lacked modems and phone lines, and that only 35% of schools and 3% of classrooms currently have access to the Internet. We know this is an equity issue—that far more than 3% of the homes in the United States have access to the Internet and that schools must make sure that students' access to information and ideas must not depend on what they get at home. We have intentionally used this example to make the point that Standard 6, Scientific Tools and Technologies, includes using telecommunications to acquire and share information. New Standards' partners have pledged to create the learning environments where students can develop the knowledge and skills delineated here.

Australian children are expected to "suggest ways of doing investigations, giving consideration to fairness; organize and use equipment to gather and present information; argue conclusions on the basis of collected information and personal experience; evaluate the fairness of a test designed and carried out."

Science—a curriculum profile for Australian schools, pp. 48-9.

Science required by the task

The National Science Research Center encourages the establishment of student research centers in schools in the United States and around the world. The Center facilitates the exchange of information by publishing a journal of student investigations and by use of the Internet (nsrcmms@aol.com). It provides a standard format that students use to report their results.

The format requires that students state a purpose and hypothesis; report their methods, data analysis, and conclusions; and suggest applications for their results. Students who use this format are therefore required to produce work related to the following Science standards:

Standard 5, Scientific Thinking;
Standard 6, Scientific Tools and Technologies;
Standard 8, Scientific Investigation.

Science evident in this student work

The student completed an investigation of yeast growth. This investigation therefore adds to the components required by the format evidence for conceptual understanding of the following part of:

Standard 2, Life Sciences Concepts—characteristics of organisms (needs, environments that meet them).

Life Sciences Concepts

By investigating the optimum temperature for the growth of yeast, the student explores characteristics of organisms (needs, environments that meet them). The student does not mention sugar but reports following the instructions on the package. Although sugar is necessary for "proofing" yeast, it is not necessary for "activation." The package indicates that the yeast is to be "dissolved" in water (¼ cup) at a temperature between 105 and 115 degrees Fahrenheit. If it is to be proofed (foamy), a teaspoon of sugar is added. After five minutes in warm water, the yeast will begin to multiply with added food. If sugar was used, it can be assumed that equal amounts of sugar had been added to the water.

At a more advanced level, a more "sophisticated" analysis would be expected: one that shows that the results at 100 degrees and 110 degrees are essentially the same. Further, students might study the way yeast is used to show that yeast solutions cool slightly during use, so that it is good to start with a somewhat higher water temperature (some recipes call for water at 120 to 130 degrees).

Scientific Thinking

This work also provides evidence for parts of Scientific Thinking. The question about yeast growth is well within the reach of an elementary school student. The package instructions were used as a reliable source of information. The testing and questioning of that source best provide evidence for the quality of work expected for this standard.

Scientific Tools and Technologies

The procedure of using a microscope to count cells and the persistence shown by counting 232 cells while viewing them through a microscope is impressive use of scientific tools and technologies for an elementary student.

Measurement issues related to repeated sampling from the same container, repeated trials, and checking the temperature of the water would be expected of a middle school student but are not expected at the elementary level.

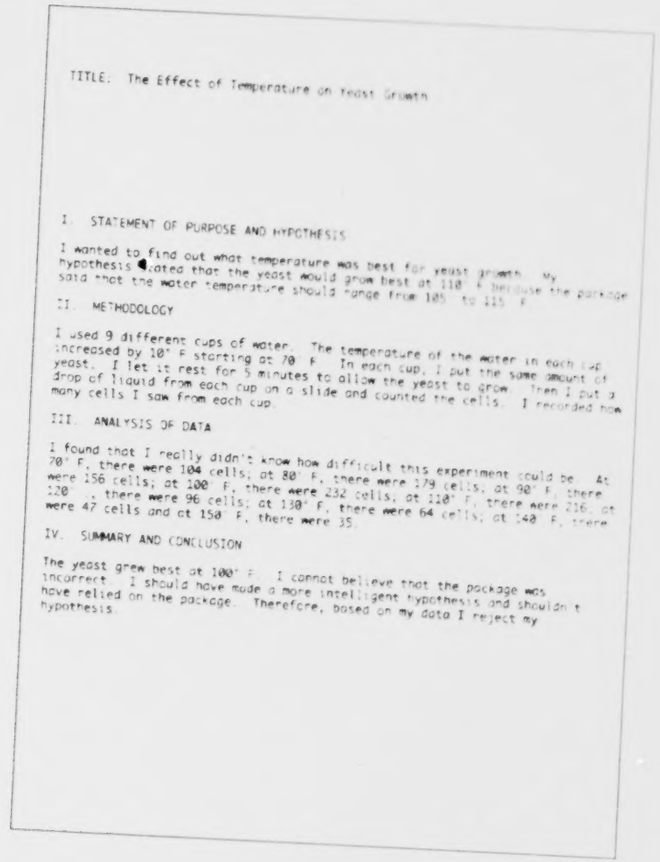
Controlling the time allowed for growth is explicitly mentioned. Controlling the shape of the container and the amount of sugar are not mentioned.

Scientific Investigation

This work provides evidence of the quality of work expected for some parts of this standard. The question is appropriate and the hypothesis reasonable; the procedures are reported in ways that others could replicate; the report is clear and straightforward. The conclusion, that the hypothesis should be rejected, is correct. The idea that the hypothesis was not intelligent and that the student would have had a basis better than the package instructions is not warranted. The fact that the package could have been correct and the temperature measurements could have been flawed in some way (inaccurate thermometer, for example) is an alternative explanation for the data. As noted above, however, analysis of some of the measurement issues is more sophisticated than would be expected for an elementary student. Finally, the willingness to report a result different from the hypothesis is a major accomplishment for an elementary student.

Going beyond

This work is adequate for a portfolio entry, as an example of work that provides evidence for Scientific Investigation. It would be strengthened by more attention to the measurement issues.



TITLE: The Effect of Temperature on Yeast Growth

I. STATEMENT OF PURPOSE AND HYPOTHESIS

I wanted to find out what temperature was best for yeast growth. My hypothesis stated that the yeast would grow best at 110° F because the package said that the water temperature should range from 105° to 115° F.

II. METHODOLOGY

I used 9 different cups of water. The temperature of the water in each cup increased by 10° F starting at 70° F. In each cup, I put the same amount of yeast. I let it rest for 5 minutes to allow the yeast to grow. Then I put a drop of liquid from each cup on a slide and counted the cells. I recorded how many cells I saw from each cup.

III. ANALYSIS OF DATA

I found that I really didn't know how difficult this experiment could be. At 70° F, there were 104 cells; at 80° F, there were 179 cells; at 90° F, there were 156 cells; at 100° F, there were 232 cells; at 110° F, there were 216; at 120° , there were 96 cells; at 130° F, there were 64 cells; at 140° F, there were 47 cells and at 150° F, there were 35.

IV. SUMMARY AND CONCLUSION

The yeast grew best at 100° F. I cannot believe that the package was incorrect. I should have made a more intelligent hypothesis and shouldn't have relied on the package. Therefore, based on my data I reject my hypothesis.

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1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	Statistics & Probability Concepts	Problem Solving & Mathematical Reasoning	Mathematical Skills & Tools	Mathematical Communication	Putting Mathematics to Work

Mathematics

1	2	3	4	**5**	**6**	**7**	8
Physical Sciences Concepts	Life Sciences Concepts	Earth & Space Sciences Concepts	Scientific Connections & Applications	**Scientific Thinking**	**Scientific Tools & Technologies**	**Scientific Communication**	Scientific Investigation

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

Science required by the task

The National Science Research Center encourages the establishment of student research centers in schools in the United States and around the world. The Center facilitates the exchange of information by publishing a journal of student investigations and by use of the Internet (nsrcmms@aol.com). It provides a standard format that students use to report their results.

The format requires that students state a purpose and hypothesis; report their methods, data analysis, and conclusions; and suggest applications for their results. Students who use this format and report it on the Internet are therefore required to produce work related to the following Science standards:

Standard 5, Scientific Thinking;
Standard 6, Scientific Tools and Technologies;
Standard 7, Scientific Communication.

Science evident in this student work

As part of their work in mathematics, fourth grade students chose to gather data on sizes of different body parts and to compare their data with first grade students. Having done so, they then used the Internet to locate a seventh grade class that was willing to provide comparable data. They then "published" their work by reporting it on the Internet in the standard format, providing evidence for Standards 5, 6, and 7.

Scientific Thinking

This lab report provides evidence related to the following parts of Scientific Thinking:

The student uses scientific reasoning strategies, scientific knowledge, and common sense to formulate questions about, understand, and explain a wide range of phenomena; that is, the student:

- **asks questions about objects, organisms, and events in the world.**

Questions about body sizes are of great interest to children. The value of allowing students to formulate their own questions is demonstrated by their including "smiles" in the list of body parts, something that would not occur to many adults.

- **seeks information from reliable sources, including scientific knowledge, observation, and trying things out.**

These students went beyond their immediate experience by seeking out a seventh grade class so that they could extend their study beyond the grade levels contained in their elementary school.

- **uses evidence to construct an explanation; recognizes a fair test.**

The use of the data from the first graders to construct the hypothesis for the seventh graders is evidence for this part of the standard.

- **recognizes others' points of view; checks his or her own and others' explanations against experiences, observations, and knowledge.**

The students checked their data against their prediction, which had been based on a reasonable idea that comparable rates of growth would be observed over the three year spans prior to and following their age. They were surprised by the results.

- **works individually and in teams to collect and share information and ideas.**

Working as a class and with other classes, even classes outside their own school, demonstrates the beginnings of a scientific community that shares data and publishes results.

Scientific Tools and Technology

This lab report also provides evidence related to the following parts of Scientific Tools and Technologies:

The student uses tools and technologies to collect and analyze data; that is, the student:

- **uses simple technology and tools to gather data and extend the senses, for example, rulers, balances, thermometers, watches, magnifiers, and microscopes.**

The tools are not identified, nor are the procedures for measuring (e.g., were smiles measured at their greatest length? corner to corner or edge of the lips?), but measurements are reported in a reasonable way. The middle school students, who measured themselves, reported with more significant digits, which is probably appropriate.

- **collects and analyzes data, using concepts and skills in Mathematics Standard 4.**

The results of the analysis are reported here but not the procedures. A report of the data, which would be required in a full investigation (Standard 8 in both Mathematics and Science), would reveal the adequacy of the sample and the appropriateness of using the average.

- **acquires information from print and non-print sources.**

Information was acquired electronically and by direct measurement.

Scientific Communication

This lab report provides evidence related to several parts of Scientific Communication:

The student communicates clearly and effectively about the natural world; that is, the student:

- **represents data and results in more than one way, for example, numbers, drawings, words, tables.**

The data are explained in both a text and a table. A bar graph might have been an effective way to show the contrast from first to fourth to seventh grade.

- **uses facts to support conclusions.**

Conclusions follow directly from the data.

- **writes instructions that others can follow.**

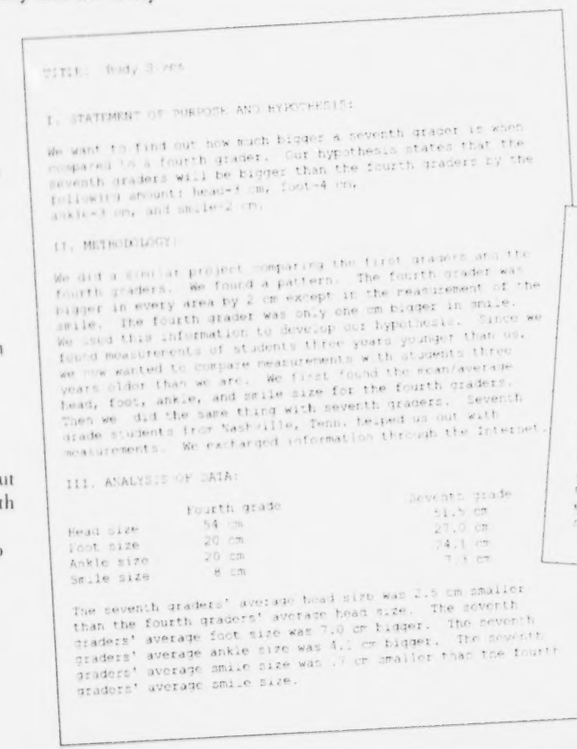
The procedure reported here is not detailed enough to follow, but one would expect that the seventh graders asked questions before proceeding, if the instructions to them had been unclear.

- **communicates in a form suited to the purpose and the audience; uses data to resolve disagreements.**

The report follows the NSRC format completely and clearly.

Going beyond

This work provides evidence that approaches the quality expected for Standards 5, 6, and 7. Attempting to explain the unexpected results, that the seventh graders had smaller heads and smiles, by critiquing the measurement procedure, would have provided more complete evidence for Standards 5 and 6. Attempting to explain the results, by pursuing (for example) developmental reasons for heads attaining their adult size in babies and children more rapidly than limbs do, would have taken the investigation into Standard 2, Life Science Concepts. Gathering a larger sample would have addressed parts of Mathematics Standard 4, Statistics and Probability. The work sample presented here stands out, in any case, because of the students' use of the Internet as a tool for learning and exchange of data.



TITLE: Body Sizes

I. STATEMENT OF PURPOSE AND HYPOTHESIS:

We want to find out how much bigger a seventh grader is when compared to a fourth grader. Our hypothesis states that the seventh graders will be bigger than the fourth graders by the following amounts: head=1 cm, foot=4 cm, ankle=4 cm, and smile=2 cm.

II. METHODOLOGY:

We did a similar project comparing the first graders and the fourth graders. We found a pattern. The fourth grader was bigger in every area by 2 cm except in the measurement of the smile. The fourth grader was only one cm bigger in smile. We used this information to develop our hypothesis. Since we found measurements of students three years younger than us, we now wanted to compare measurements with students three years older than we are. We first found the mean/average head, foot, ankle, and smile size for the fourth graders. Then we did the same thing with seventh graders. Seventh grade students from Nashville, Tenn. helped us out with measurements. We exchanged information through the Internet.

III. ANALYSIS OF DATA:

	Fourth grade	Seventh grade
Head size	54 cm	51.5 cm
Foot size	20 cm	27.0 cm
Ankle size	20 cm	24.1 cm
Smile size	8 cm	7.3 cm

The seventh graders' average head size was 2.5 cm smaller than the fourth graders' average head size. The seventh graders' average foot size was 7.0 cm bigger. The seventh graders' average ankle size was 4.1 cm bigger. The seventh graders' average smile size was .7 cm smaller than the fourth graders' average smile size.

IV. SUMMARY AND CONCLUSIONS:

In our survey, seventh graders tended to have slightly smaller heads and smiles than fourth graders. We are not sure why the seventh graders' heads were smaller than the fourth graders' head. Also, seventh graders tended to have larger feet and ankles than fourth graders. Therefore, we reject our hypothesis at every area.

V. APPLICATION TO LIFE:

Doctors would want to know the average heights for each age group to see if their patients are in the average group or not. Parents would want to know this information for the same reason. Clothing companies would want to know these measurements for hat sizes, shoe sizes, and sock sizes for each age group. Modeling agencies might be interested in smile sizes.

The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 62-63.

French students are expected "to be able to propose the procedure for characteristic steps of the experimental process and especially: to design and assemble the apparatus; to isolate a variable and design a relevant experiment; to take account of the need for measurement and know how to carry out simple measurements; to present and interpret results; to argue and discuss an experiment or study scientifically."

Les cycles 'a l'école primaire, pp. 68-9.

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Work Sample & Commentary: *Fire-Belly Newts*

1	2	3	4	5
Reading	Writing	Speaking, Listening & Viewing	Conventions, Grammar & Usage	Literature

English Language Arts

1	2	3	4	5	6	7	8
Arithmetic & Number Concepts	Geometry & Measurement Concepts	Function & Algebra Concepts	Statistics & Probability Concepts	Problem Solving & Mathematical Reasoning	Mathematical Skills & Tools	Mathematical Communication	Putting Mathematics to Work

Mathematics

1	2	3	4	5	6	7	8
Physical Sciences Concepts	**Life Sciences Concepts**	Earth & Space Sciences Concepts	Scientific Connections & Applications	**Scientific Thinking**	Scientific Tools & Technologies	**Scientific Communication**	**Scientific Investigation**

Science

1	2	3	4	5
Problem Solving	Communication Tools & Techniques	Information Tech. Tools & Techniques	Learning & Self-mgmt. Tools & Techniques	Tools & Techniques for Working With Others

Applied Learning

The quotations from the Science performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 62-63.

Best practice in Science has always included extensive inquiry and investigation, but it is frequently given less emphasis at the elementary level in the face of competing demands from English Language Arts and Mathematics. There are many opportunities to learn Science outside of school, including Scouts, Boys and Girls Clubs, 4-H and Future Farmers of America. The work done in these venues can and should be used to provide evidence of meeting the standards.

Science required by the task

An elementary student participated in a 4-H program in which she raised an animal, learning about and caring for its needs. The culmination of this project involved a county-wide fair in which the student's project was judged against other similar projects. The task involved observation of the animal, some library research, the production of a display and a report, and an interview with the judge. The student's original report and a follow-up interview are included here.

This work sample provides evidence related to parts of the following Science standards:

Standard 2, Life Sciences Concepts—characteristics of organisms (needs, environments that meet them; structures, especially senses; variation and behaviors, inherited and learned); life cycles, including birth, development, reproduction; organisms and environments, in particular, food chains, populations, effects on the environment;

Standard 5, Scientific Thinking—seeks information from reliable sources; checks his or her own and others' explanations against experiences, observations, and knowledge;

Standard 7, Scientific Communication—represents data and results in more than one way;

Standard 8, Scientific Investigation.

Science evident in this student work

This student's report on newts condenses the information on this particular amphibian into just what one would need to know to raise this animal, but includes sufficient information to provide evidence of understanding several parts of Standard 2, Life Sciences Concepts. The interview demonstrates a greater depth of understanding, as the ability to field questions about the work shows an important part of Standard 8, Scientific Investigation.

Life Science Concepts

An understanding of the characteristics and environmental needs of organisms is evident throughout the work, from "background" to "other information." The work shows a clear understanding of this organism's characteristics, as well as many of the factors necessary for its health and survival.

Information presented in the interview shows that an environment specifically designed to meet the needs of a Fire Belly Newt had been constructed.

There is some evidence for attention to the life cycle in this work. The section which explains mating illustrates understanding of the reproductive cycle of this animal. Similarly, the reference in the interview to the animal's ability to breathe in water, like fish, when the newt was "really little" and to breathe air "now...which is different," shows awareness that the animal changes over time from birth to adult.

The enemies listed included the organism, hydra. It is unlikely that hydra is an enemy to an adult newt. However, hydra could pose a threat to the newt in the larval stage.

Scientific Thinking

Information from multiple sources is evident throughout this work sample, including direct observation, several books, and conversations with experts, e.g. the people at the pet store, though "they didn't know very much except for feeding and they looked that up." The student compares what the books said with her observations, e.g. reading in a book that males have a crest but saying that she has not seen a newt with a crest, and attributes information derived from multiple and different kinds of sources. This shows a sensitivity to accuracy of information that is sophisticated for elementary school level.

Scientific Communication

The results of the student's investigation were reported in a variety of media (writing, display, interview), as required by the 4-H program. This variety is effective for reporting the results of any investigation and for demonstrating understanding.

Scientific Investigation

This work also illustrates several parts of Scientific Investigation, where a full investigation includes:

- **questions that can be studied using the resources available;**
- **procedures that are safe, humane, and ethical; respect privacy and property rights;**
- **data that have been collected and recorded *(see also Science Standard 6)* in ways that others can verify, and analyzed using skills expected at this grade level *(see also Mathematics Standard 4)*;**
- **data and results that have been represented *(see also Science Standard 7)* in ways that fit the context;**
- **recommendations, decisions, and conclusions based on evidence;**
- **acknowledgment of references and contributions of others;**
- **results that are communicated appropriately to audiences;**
- **reflection and defense of conclusions and recommendations from other sources and peer review.**

This work shows a common elementary school investigation involving an organism (pet) readily available for observation. However, in the process of finding out how to care for this animal, the student engaged in several activities that are part of any systematic observation. Specifically, direct observation of the animal and the record made of that observation included a comparison between actual behaviors of the newt and data provided by books. The recorded data are not included in the report but were recalled in the interview.

The 4-H program carefully spells out the procedures and protocol for dealing with animals. The procedure is humane and ethical, with careful attention to safety for both the animal and the handler. Both the written report and the interview mention the need to use wet hands so as to avoid tearing the newt's thin skin, for example. Similarly, the work provides evidence for attention to specific requirements of the organism, where the student discusses feeding the newt the right amount of food, keeping the tank clean, and providing a rock so that the newt could climb out of the water.

Other parts of Standard 8, Scientific Investigation are discussed above under the headings: Scientific Thinking and Scientific Communication.

Going beyond

The quality of this work meets the standard for substantial parts of Life Science Concepts and several important parts of Scientific Thinking and Scientific Communication. It only approaches the standard for Scientific Investigation at the elementary level. The work would provide a stronger example of a complete investigation at the elementary level if it were accompanied by the missing data. Work appropriate for investigations placed in a portfolio would include data of the kind that is missing in this work sample.

FIRE - BELLY NEWTS

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BACKGROUND: Newts are amphibians (can live on land and in water) and are similar to salamanders, not lizards. They have soft toes with four on the front and five on the back. They are very smooth. The tail is flat for swimming purposes. They can regrow missing tails, legs and jaws. They have no eardrums, so they hear through vibrations through their front legs and lower jaw. They are also voiceless. They can locate by means of smell. When picking up a newt, wet your hands so not to tear the skin.

CARE: The newt is fed once a day. I clean its tank twice a month. In doing this I must rinse off the rocks and scrub off the algae from the sides of the tank. I also have to clean off the air pump.

NUTRITION: In the wild newts will eat small insects. If a newt is starving it will eat scraps of meat.

FEEDING: Sarah (my newt) is fed shrimp pellets. We feed her one pellet a day. The pellets smell so bad that we keep them in a ziploc bag. Sarah doesn't usually eat while we are looking. She prefers to be alone. They can be trained to eat right out of your hand. You can also put meat or flies on a stick to make it look like the food is alive.

HOUSING: Sarah (my newt) lives in a tank with a water filter, gravel and 2 large stones. She likes to hide between the two stones. Since Sarah has gone to school and the nursing home we have purchased a small travel tank. The tanks are never completely filled with water. She likes to get on top of the large rocks and out of the water.

HEALTH: I have had Sarah for 4 years, newts seem to live longer then fish. She prefers to be alone. When she walks on land she walks like a crocodile. When they are small they look like a guppy.

MATING: They have a certain ritual that only that species recognizes to mate. They do a dance that other newts will recognize. Some newts have a fluid they put out into the water and the females will follow the smell behind the males. Some male newts develop a crest on their heads and a fancy tail during breeding season.

OTHER INFORMATION: Newts skin gets to tight when they grow and they shed it like a snake. Then they eat it. Their enemies in the wild are Hydra, people, and under water animals. When they think they are in danger they turn on their back. Their is black, orange, and gray on their stomach. Then they match their surroundings. They also have a bad taste that their skin gives off.

OTHER TYPES OF NEWTS: Some different kinds of newts are Japanese Newts (black back, bright red belly); Red-Spotted Newts (lives on land as a youth and in the water as an adult, it's brown flecked with red), Smooth or Warty Newt (during mating this newt developes a crest along its back and tail); California Newt (brown with a yellow belly).
Sarah is a fire-belly newt, this is seen by the orange on her stomach.

Some information on newts I got from these books:
The Little Red Newt by Louise Harris and Norman Harris
Frogs, Toads, Lizards, and Salamanders by Nancy Parker and Joan Wright
Amphibians As Pets by George and Lisbeth Zappler
Loveburds, Lizards and Iammas by Leda and Rhoda Blumberg
Frogs, Toads, Salamanders, and How they Reproduce by Dorthy Hinshaw Patent
Pets by Frances Chrystie

Overall, in taking care of Sarah I have learned that they are easy to care for but are a pretty boring pet. They don't give you love like a dog.

Student Interview: Fire Belly Newts

Q: Tell me about your 4-H project with the Fire Belly Newt.

A: Her name is Sara and she is an amphibian. I was going to get an iguana, but Mom said I should get a smaller animal.

Q: What did you have to learn to raise the newt?

A: I had to read books. But there weren't a lot of books at the pet store and only one at the library. I got some things out of encyclopedias. I had to learn they are amphibians and need land and water to live. They have soft toes for climbing on land and a tail that helps them swim. Oh, and if they get bitten or caught they can lose a tail or leg and grow it back.

Q: How did you know what to feed her?

A: At the pet store, they said to feed her shrimp pellets that smell really bad. In the books I read, they said that in the wild newts will eat insects and, if they are starving, they will eat meat. We put some food on a stick to feed her sometimes. That makes the food look alive. Sara likes to eat when nobody is looking. I feed her only one pellet a day or she will get sick or the tank will get ickey.

I had to keep the tank between 72 and 82 degrees. Sara is cold-blooded and that means she gets sick if it gets too cold or too hot. Like, if it is 72 degrees then she will be that and if it is hot, she will be hot. We got this sticky thermometer so if it gets too hot we would....I mean if it gets too cold we would turn on this heater here. And I have to clean the tank once a week..

Q: How do you do that?

A: I have to take Sara out and I put her in here *(small bowl)*. Then I have to clean off the algae with a scraper and clean the filter and it smells sometimes. Then I have to put in new water once in a while. But that's only once or twice so far. And I put this powder in so the stuff in the water doesn't make her sick or die.

Q: Is Sara a female? How could you tell?

A: Newts that are male have a crest on their back. I haven't seen a newt with that though. But since my newt doesn't have one I thought she was a female. I want to see if I can find a male newt and breed them. But I can't find any books on how to do that.

Q: How about the pet store people? Could they tell you?

A: They might know. But our pet store has lots of fish and only a few newts and a couple of geckos. I asked them about newts and they didn't know very much except for feeding and they looked that up.

Q: Would you like to tell me how they mate?

A: Yes. They have a dance that only other newts will recognize. Then the male newt will spray the water with a liquid and the female will follow the smell and lay her eggs there. It sounds kind of gross. Then the male newt sort of takes off and the female stays there and guards the eggs. I don't know if she guards them until they hatch and I don't know how many baby newts they have.

Q: What about how newts protect themselves?

A: If they think they are in danger they turn on their backs. I think the colors on their stomach maybe are scary to other animals. But the newt can grow back a leg or a tail if it gets eaten and one book says they taste really bad in their skin.

Q: Tell me about raising your newt as a 4-H project.

A: Well, I had to learn all about my newt and I had to tell a 4-H judge about my newt at the fair. I had this paper I wrote about Sara on my table and I had Sara there, too.

Q: Did the judge ask you questions and how did you answer them?

A: Yes. I said, 'My name is ...' and 'Would you like to know about my newt?' Then he said, 'Yes.' I told him, 'My newt is named Sara and she is an amphibian.'

Q: So you pretty much had this whole report memorized?

A: Yeah, my Mom helped me with the subjunctive mood and went over and over it a lot.

Q: What else did you do with Sara in this project? Did you have to watch her over time or anything like that?

A: Oh yeah, I had to learn about her from books and from watching her every day. I sometimes kept notes on what she did to see if she was like the newts in the books.

Q: What did you learn from watching Sara?

A: I learned that she likes to spend a lot of time under this rock and she likes to stay away from the bubble thing. But she likes to come out on this rock so she can be out of the water. Oh, and we had to make sure the lid was on this tank because she would get out.

Q: Did she get out?

A: Once she almost got out and my Dad saw her and put her back in. Oh, and you have to make sure your hands are wet, because newts have really thin skin and it can tear.

Q: Does she stay underwater for a long time?

A: Yeah, I timed her sometimes and she stayed under about 30 minutes and sometimes more. She breathes air but when she was really little I think she had what fish have.

Q: Gills?

A: Yeah, and now she can breathe air which is different and she's an amphibian and can go underwater and on land too.

Japanese teachers are given the following "special considerations for teaching" science throughout elementary school: "Consideration should be paid to helping students grasp the characteristics of nature through such activities as observing, searching for, raising and producing various things in nature, and also to enhancing the effectiveness of teaching especially in relation to various activities concerning language, arithmetic and handicraft; for the guidance of observations, experiments, cultivation of plants, raising of animals and production, attention should be paid to the prevention of accidents; for teaching about living things, weather, river, strata, etc., it is necessary to take pupils outside the school, to get close contact with the regional nature, and to develop an interest in the preservation of nature."

Course of Study for Elementary Schools in Japan, p. 70.

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Samples of student work that help explain "how good is good enough" for these standards can be found immediately following these pages.

To see how these performance descriptions compare with the expectations for middle school and high school, turn to pages 106-110.

The standards for Applied Learning have been revised substantially since the last published draft of these Performance Standards. Contact New Standards for information about the content framework that has provided the foundation for the Applied Learning standards.

These performance descriptions contain extensive cross-referencing, both between Applied Learning and English Language Arts, Mathematics, and Science, and among the Applied Learning standards.

The cross-referencing to English Language Arts, Mathematics, and Science is intended to illustrate some of the ways by which Applied Learning may be integrated with the subject areas and may provide a vehicle for learning in the disciplines. These references are shown only for Standard 1, Problem Solving.

The cross-referencing among the Applied Learning standards is intended to illustrate some of the ways by which a single project can provide a vehicle for demonstrating achievement of a number of Applied Learning standards. It is intended that Applied Learning tools and techniques be developed in conjunction with problem solving projects, rather than as isolated skills.

1. Problem Solving

Apply problem solving strategies in purposeful ways, both in situations where the problem and the desired solutions are clearly evident and in situations where they are not.

The student completes projects involving at least two of the following kinds of problem solving each year and, over the course of elementary school, projects involving all three kinds of problem solving.

- **Designing: identifying needs that could be met by new products, services, or systems; and creating solutions for meeting them;**
- **Planning and Organizing: taking responsibility for all aspects of planning and organizing an event or activity from concept to completion, making good use of the resources of people, time, money, and materials and facilities;**
- **Improving a System: developing an understanding of the way systems of people, machines, and processes work; troubleshooting problems in their operation; and devising strategies for improving their effectiveness.**

A single project may involve more than one kind of problem solving.

DESIGNING

The student designs a product, service, or system to meet an identified need; that is, the student:

- **develops ideas for design of the product, service, or system;**
- **identifies factors affecting choice of the best idea for the design and makes a decision based on those factors;**
- **selects and uses an appropriate form for presenting the design plan;**
- **establishes criteria for judging the success of the design;**
- **plans and carries out the steps of the production process;**
- **evaluates the quality of the design by considering the criteria for success and by comparison with similar products, services, or systems.**

Examples of designing include:

- designing a tree house, accounting for physical and financial constraints *(see also Applied Learning Standard 2; Mathematics Standards 2 and 8);*
- designing a guide to the school library for younger children *(see also Applied Learning Standards 3, 4, and 5; English Language Arts Standard 2);*
- designing and producing a weekly school news service for broadcast on the PA system or closed circuit video network *(see also Applied Learning Standards 4 and 5; English Language Arts Standard 3);*
- designing a classroom work area for ongoing project work;
- designing a weather station and providing a daily weather reporting service for the school *(see also Applied Learning Standards 2, 4, and 5; Mathematics Standards 1 and 4; Science Standard 3);*
- designing a musical instrument *(see also Applied Learning Standard 3; Science Standards 1 and 8).*

PLANNING AND ORGANIZING

The student plans and organizes an event or activity; that is, the student:

- **develops a plan that:**
  - **includes all the factors and variables that need to be considered;**
  - **makes sense in terms of the order in which things need to be done;**
  - **makes sense in terms of the people, time, and resources available to put the plan into action;**
  - **is described clearly enough for someone else to use it;**
- **implements the plan;**
- **evaluates the success of the event or activity, identifying the parts of the plan that worked best and the aspects that could have been improved by better planning and organization, and proposing how the improvements could have been achieved;**
- **makes recommendations to others who might consider planning and organizing a similar event or activity.**

Examples of planning and organizing an event or activity include:

- organizing a storytelling conference *(see also Applied Learning Standards 2 and 5; English Language Arts Standard 5);*
- arranging for a meteorologist to talk to the class as part of the weather station project *(see also Applied Learning Standards 2, 4, and 5; Science Standard 3);*
- planning a class excursion to the zoo or museum *(see also Science Standard 2);*
- organizing a drive to raise money for a specific purpose *(see also Applied Learning Standards 2 and 3; Mathematics Standards 1 and 4);*
- planning a camping expedition, including all necessary supplies and a budget *(see also Applied Learning Standard 2; Mathematics Standards 1 and 8; Science Standard 2).*

IMPROVING A SYSTEM

The student troubleshoots problems in the operation of a system in need of repair or devises and tests ways of improving the effectiveness of a system in operation; that is, the student:

- **identifies the parts of the system and the way the parts connect with each other;**
- **identifies parts or connections in the system that have broken down or that could be made to work better;**
- **devises ways of making the system work again or making it work better;**
- **checks whether the strategies worked.**

Examples of troubleshooting problems in the operation of a system or improving the effectiveness of a system in operation include:

- repairing a bicycle, skateboard, or other means of transportation *(see also Applied Learning Standard 5);*
- improving the system for distributing sports equipment during recess and lunch times *(see also Applied Learning Standard 2);*
- cleaning up an aquarium *(Applied Learning Standards 2 and 3; Science Standard 2);*
- improving the system for collecting trash in the school *(see also Applied Learning Standards 2 and 5; Mathematics Standards 3, 4, and 7; Science Standard 7);*
- investigating the food choices of students buying food from vending machines near the school and making recommendations for ways of improving the nutritional value of the food available *(see also Applied Learning Standards 2 and 3; Mathematics Standard 8; Science Standards 4 and 6).*

2. Communication Tools and Techniques

Communicate information and ideas in ways that are appropriate to the purpose and audience through spoken, written, and graphic means of expression.

The student makes an oral presentation of project plans or findings to an appropriate audience; that is, the student:

- **organizes the presentation in a logical way appropriate to its purpose;**
- **speaks clearly and presents confidently;**
- **responds to questions from the audience;**
- **evaluates the effectiveness of the presentation.**

Examples of oral presentations include:

- presenting to the custodian proposals for improving the system of collecting trash in the school *(see also Applied Learning Standards 1 and 5; English Language Arts Standard 3);*
- presenting to the principal a proposal for an overnight camping trip *(see also Applied Learning Standard 1; English Language Arts Standard 3);*
- presenting to a school assembly results of a fund raising drive *(see also Applied Learning Standards 1 and 3; English Language Arts Standard 3);*
- presenting to the class the results of a project to clean up an aquarium *(see also Applied Learning Standards 1 and 3; English Language Arts Standard 3; Science Standard 7).*

The student composes and sends correspondence, such as thank-you letters and memos providing information; that is, the student:

- **expresses the information or request clearly;**
- **writes in a style appropriate to the purpose of the correspondence.**

Examples of letters and memos include:

- writing a letter inviting students at another school to a storytelling conference *(see also Applied Learning Standards 1 and 5);*
- writing a letter of thanks to a visiting speaker *(see also Applied Learning Standard 1);*
- writing a memo asking teachers to explain to their classes new procedures for distributing sports equipment during recess and lunch times *(see also Applied Learning Standard 1).*

The student writes and formats information for short publications, such as brochures or posters; that is, the student:

- **collects information to include in the publication;**
- **organizes the information into an appropriate form for use in the publication;**
- **checks the information for accuracy;**
- **formats the publication so that it achieves its purpose.**

(Communication Tools and Techniques Performance Descriptions continued on next page.)

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3. Information Technology Tools and Techniques

(continued)

Examples of writing and formatting information for publication include:

- designing a format for publishing daily weather reports *(see also Applied Learning Standards 1, 4, and 5);*
- designing a poster advertising a fund raising drive *(see also Applied Learning Standards 1 and 3);*
- producing a program for a storytelling conference *(see also Applied Learning Standards 1 and 5).*

The student translates information from one format to another; that is, the student:

- **chooses a different format that is appropriate for presenting information to better suit the purpose for communicating it;**
- **checks that the information has been translated accurately into the new format;**
- **gives reasons for any changes made in the information, such as deciding to leave some information out.**

Examples of translating information from one format to another include:

- translating from the physical world to a map, e.g., producing a map to show people where events will be held during a storytelling conference *(see also Applied Learning Standards 1 and 5);*
- translating from statistics to graphics, e.g., using bar charts to show the nutritional value of different kinds of food available from a vending machine *(see also Applied Learning Standard 1);*
- translating from a plan to a sketch drawing, e.g., producing an artist's sketch of the way a tree house will look when constructed *(see also Applied Learning Standard 1).*

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3. Information Technology Tools and Techniques

Use information technology to collect, analyze, organize, and present information.

The student:

- **uses word processing, graphics, and drawing programs;**
- **uses an electronic card catalogue.**

Examples of using information technology tools and techniques include:

- using word processing and drawing programs to design a guide to the library for younger students *(see also Applied Learning Standards 1, 4, and 5);*
- using a graphics program to present daily results of a fund raising drive *(see also Applied Learning Standards 1 and 2);*
- using an electronic card catalogue to research information on sound for the design of a musical instrument or to find out about the requirements of freshwater animals and plants for a project to clean up an aquarium *(see also Applied Learning Standards 1 and 2).*

4. Learning and Self-management Tools and Techniques

Manage and direct one's own learning.

The student learns from role models; that is, the student:

- **consults with or observes older students and adults at work and identifies the main features of what they do, the way they go about their work, and the qualities of the products they produce;**
- **takes account of role models in planning and conducting his or her own project activities.**

Examples of learning from role models include:

- examining published guides similar in design to the students' proposed guide to the library *(see also Applied Learning Standards 1, 3, and 5);*
- studying the way news reports are presented on radio and television to inform development of the students' own newscasts *(see also Applied Learning Standards 4 and 5);*
- shadowing an older student for a day;
- visiting a meteorological station and observing the work of forecasters to inform the weather station project *(see also Applied Learning Standards 1, 2, and 5).*

The student keeps records of work activities in an orderly manner; that is, the student:

- **sets up a system for storing records of work activities;**
- **maintains records of work activities in a way that makes it possible to find specific materials quickly and easily.**

Examples of tools and techniques for keeping records of work activities include:

- maintaining a project log book;
- creating and using a table of contents;
- using dividers or colored tabs to categorize material.

The student identifies strengths and weaknesses in his or her own work; that is the student:

- **understands and establishes criteria for judging the quality of work processes and products;**
- **assesses his or her own work processes and products.**

Examples of tools and techniques for identifying strengths and weaknesses in one's own work include:

- making a list of the desirable qualities of a piece of work before starting and using the list to review and revise the work at the end;
- using a review of previous project work to guide planning of a new project;
- asking a friend to critique a piece of work in draft form.

5. Tools and Techniques for Working With Others

Work with others to achieve a shared goal, to promote on-the-job learning, and to respond effectively to the needs of a client.

The student works with others to complete a task; that is, the student:

- **reaches agreement with group members on what work needs to be done to complete the task and how the work will be tackled;**
- **takes a share of the responsibility for the work;**
- **consults with group members regularly during the task to check on progress in completing the task, to decide on any changes that are required, and to check that all parts have been completed at the end of the task.**

Examples of working with others to complete a task include:

- working on the production of a weekly school news service *(see also Applied Learning Standards 1 and 4; English Language Arts Standard 3);*
- sharing responsibility for collecting information from a weather station and preparing daily reports *(see also Applied Learning Standards 1, 2, and 4; English Language Arts Standard 3);*
- organizing a storytelling conference *(see also Applied Learning Standards 1 and 2; English Language Arts Standard 3).*

The student shows or explains something clearly enough for someone else to be able to do it.

Examples of showing or explaining something to someone else include:

- showing how to fix a specific breakdown in a bicycle *(see also Applied Learning Standard 1);*
- explaining how to figure out the average morning temperature recorded at school during the winter *(see also Applied Learning Standards 1, 2, and 4; Mathematics Standard 4);*
- showing how to operate a video camera *(see also Applied Learning Standards 1 and 4).*

The student identifies the needs of a client; that is, the student:

- **interprets a written request for completion of a task;**
- **asks questions to clarify the demands of a task.**

Examples of identifying the needs of a client include:

- talking with the custodian to determine problems to be solved in a system for collection of trash in the school *(see also Applied Learning Standards 1 and 2);*
- responding to a written request from a teacher to include some information in a weekly school news broadcast *(see also Applied Learning Standards 1 and 4);*
- interviewing younger children to identify sections they use in the library and things they find confusing about accessing information and using the interview to inform the design of the guide to the library *(see also Applied Learning Standards 1, 3, and 4).*

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Work Sample & Commentary: *Lights, Camera, Action!*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

The work presented from this project is not a comprehensive record of all work done as part of the project. This is partly because the project was not done with a view to providing evidence of these standards and partly because it would be neither reasonable nor appropriate to ask students to keep detailed written records of every aspect of every project. This would defeat part of the purpose of Applied Learning, which is for studenis to learn frcm projects that have strong links to the world of work. Some of these standards better lend themselves to assessment through observation and other less formal methods than through written work.

Accordingly, the range and depth of evidence on which to base commentary related to the standards varies throughout this work sample.

Applied Learning required by the task

Using a video camera, editing equipment, and computers, a bilingual class spearheads the production of a weekly campus cable news program. The newscast reports current events, celebrates achievements, and announces future activities at the school. The newscast is run on the school's closed circuit video network each Friday.

Circumstances of performance

The students meet on Monday mornings to create the script and decide what needs to be filmed for that week's newscast. The teacher participates in the discussion leading to these decisions.

The students operate the video camera, and use video editing equipment at the school district's media center on Thursday afternoons, under adult supervision.

This project gives students the opportunity to provide evidence related to the following parts of the Applied Learning standards:

Standard 1, Problem Solving—planning and organizing;

Standard 2, Communication Tools and Techniques—composes and sends correspondence; writes and formats information for short publications;

Standard 3, Information Technology Tools and Techniques—uses word processing, graphics, and drawing programs;

Standard 4, Learning and Self-management Tools and Techniques—learns from role models; identifies strengths and weaknesses in his or her own work;

Standard 5, Tools and Techniques for Working With Others—works with others to complete a task.

Problem Solving—Designing

The student designs a product, service, or system to meet an identified need; that is, the student:

- **develops ideas for design of the product, service, or system;**
- **identifies factors affecting choice of the best idea for the design and makes a decision based on those factors;**
- **selects and uses an appropriate form for presenting the design plan;**
- **establishes criteria for judging the success of the design;**
- **plans and carries out the steps of the production process;**
- **evaluates the quality of the design by considering the criteria for success and by comparison with similar products, services, or systems.**

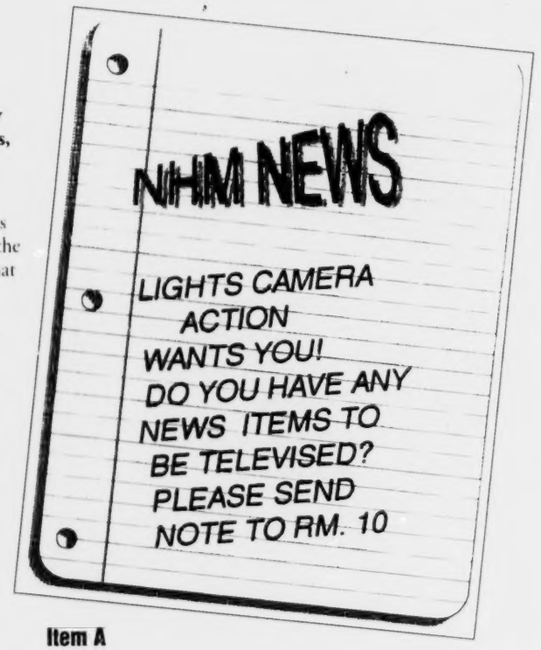
The available evidence does not allow for comment on the students' development of ideas for the design of "Lights, Camera, Action!" or the factors that affected their decisions on the format of the weekly newscast.

The evidence does demonstrate that the students planned and carried out the steps of the production process and that they have maintained a production process over time. The evidence also shows that they do so in a time critical situation, in which a newscast has to be ready for broadcast every Friday. The need to maintain production processes over time is common to the provision of services. Nevertheless the kind of commitment and organization this project requires places it at the upper end of expectations for elementary school level.

There is no direct evidence of the criteria the students have established as the basis for judging their success, but there is a range of evidence to show that the students evaluate the quality of the design and production of the newscast and make adjustments as they go.

The student writing in **Item D** outlines several changes that have been made during her time with the project and the reasons for the changes. For example: "We have stopped putting music at the end of the news since it took over an hour to edit...." **Item F** records an evaluation of the quality of the news service production. These evaluations go beyond assertion, providing supporting statements, and they reflect careful review of each week's production and discussion of ways by which the production could be improved. This provides evidence for the quality of work expected at the elementary school level.

The teacher involved with this project has reported that the students watched a variety of television news programs in preparing to produce their own.



Item A

The project includes elements of planning and organizing but is not sufficiently oriented towards solving problems of planning and organization to warrant commentary on that part of the Problem Solving standard.

There is some evidence that the project includes aspects of improving a system, such as in the references in the students' written work to ways they have sought to improve the production process. However the evidence is insufficient to allow for commentary on that part of the Problem Solving standard.

Communication Tools and Techniques

The student composes and sends correspondence, such as thank-you letters and memos providing information; that is, the student:

- **expresses the information or request clearly;**
- **writes in a style appropriate to the purpose of the correspondence.**

Item B

Good morning and welcome to the North Hl Mount Eagle News. Today is Friday, December 9, 1994. This weeks edition of the news is being brought to you by Mrs. ___ ___ class. I am _____.

Y yo soy _____ ,Favor de pararse para el Juro de lealtad

Please rise for the Pledge of Allegiance led by _____.

The birthdays this weekend are: Saturday is Kimberly and Jesus birthdays and Sunday is Timothy . Don't forget if you see them in the hall to wish them a happy birthday.

Los cumpleaños de este fin de semana son: Kimberly y Jesus este sabado y Timothy el domingo. No se olviden de desirles feliz cumpleaños

Now for the news.

The top twenty spellers of the written spelling bee were:
Third grade Averey and Whitney fourth grade:
Pierce , Louise , Mallory , Lilly
Megan , Robert , Elizabeth ,and Joshua
fifth grade Coleman , Ana , Cory ,
Matthew , Rosemary , Lauren , Batt
, Edna , Edith , Jillian , and Justin
. They will go on to the Oral Spelling Bee in January.

Los mejores ortografias del concurso de ortografia escrita fueron: tercer grado Avery y Whitney . Cuarto grado: Pierce , Louise , malolory , Lilly , Meghan , Robert , Elizabeth y Joshua . En quinto fue Coleman , Ana , Cory , Matthew , Rosemary , Lauren , Batt , Edna , Edith , Jillian y Justin . Ellos van a estar en el concurson de ortografia oral en enero.

La clase de ciencia de la Sra. ha producido un edicion especial del Environmental Times sobre especies de animales en peligro. Costará 10 centavos y los vendarán el lunes desde la s12:20 hasta las 12:45 en la cafeteria.

Mrs. science class has produced a special edition of Enviromental Times on endangered species. It will cost ten cents and will be sold on Monday from twelve twenty to twelve forty-five in the cafeteria.

Miss reading language arts had a museum on Native Americans set in the library on Wednesday for pre-kindergarten through second graders. They enjoyed it.

La clase de lectura y estudios sociales de Srta. hicieron un museo sobre las culturas de los nativos americanos para los de Kinder hasta segundo grado. Se divertieron mucho.

Item C

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While they do not strictly belong to the category of correspondence, the samples of scripts for the newscasts (**Items B** and **C**) provide evidence for the quality of work at this level. The information is expressed clearly and the style adopted takes account of the intention that the information would be heard rather than read.

The student writes and formats information for short publications, such as brochures or posters; that is, the student:

- **collects information to include in the publication;**
- **organizes the information into an appropriate form for use in the publication;**
- **checks the information for accuracy;**
- **formats the publication so that it achieves its purpose.**

Item A is a flyer soliciting news items for "Lights, Camera, Action!" It adopts an imperative voice appropriate to the purpose of the publication, is brief and to the point, and is formatted in a manner likely to draw attention.

Information Technology Tools and Techniques

The student:

- **uses word processing, graphics, and drawing programs.**

Items A, **B** and **C** are straightforward and clear examples of the quality of work expected at the elementary school level.

Learning and Self-management Tools and Techniques

The student learns from role models; that is, the student:

- **consults with or observes older students and adults at work and identifies the main features of what they do, the way they go about their work, and the qualities of the products they produce;**
- **takes account of role models in planning and conducting his or her own project activities.**

As was mentioned above, the teacher involved with this project has reported that the students studied several different TV broadcasts before settling on the format they would use. During an intersession (the school is a year round school), the students also took a mini-course on filming and editing conducted by staff from a professional cable company. These pieces of information suggest that the students undertook work relevant to learning from role models. However there is no evidence available on which to base a commentary on this part of the Learning and Self-management Tools and Techniques standard.

The student identifies strengths and weaknesses in his or her own work; that is, the student:

- **understands and establishes criteria for judging the quality of work processes and products;**
- **assesses his or her own work processes and products.**

Items D, **E**, and **F** contain a good deal of discussion of the quality of the process of production of the news service and the quality of the product itself; for example, "The newscasters could have looked up a little more; they could have put the mic box in their laps; they also could have pronounced some of the words better" (**Item F**); "From viewer's point of view you can't see the technical difficulties except that sometimes the camera's not centered or focused..." (**Item E**).

These evaluations would be strengthened by clearer connections between the proposals for changes in the product, such as appears in **Item D**: "We feel for the future we will need a larger variety of shots and maybe even go outside to film..."; and by the kinds of improvements that are expected to flow from those changes. Nevertheless the work reveals a level of attention to issues of quality and a willingness to weigh the strengths and weaknesses of the product that provides evidence for the quality of work expected at the elementary school level.

It is notable that most of the evaluative comments are cast in the third person rather than directed towards identifying strengths and weaknesses in the students' own contributions to the effort. Exceptions are the reference to centering and focusing the camera in **Item E** (earlier in this piece the student identifies himself as being a member of the camera crew) and the comment in **Item D** that "the hardest part is keeping up with my schedule and setting the camera up."

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Item D

Dear and Louise
I am a beginner at Lights Camera Action.
I have learned alot in the past month.
The hardest part is keeping up with
my schedule and setting the camera up.
The easiest thing is changing the batteries.
We have to make up all the work we
miss when we're filming. Editing is fun
and work. If it is your week to film
you have to edit as well. We edit
every Thursday after school. It takes about
three hours. It's fun usually because
we get cakes and snacks while were
editing. It takes alot of hard work and
patience to edit. We changed alot of
things about our news since I began.
We have stopped putting music at the
end of the news since it took over an
hour to edit, and we also added credits
at the end of the news.
We feel for the future we will need
a larger variety of shots and maybe even
go outside to film the news sometimes.
We need more footage of actual events and
hope to get it to the point where it's
ready to go on cable T.V.

Item E

I think the news has improved greatly since the first news that the Lights, Camera, Action put on air. I being a person on the camera crew and also a viewer see the news a time or once on friday, the broadcast of the news, and on Monday, the day of the Lights, Camera, Action meeting, from a viewers point of view you can't see the tecnical difficulties except that sometimes the camera's not centered or focused and that sometimes the news casters mis pronounce a word. Other than that you can't see any other tecnical difficulties until you see the news a second time.

Written by Charles

Item F

The news was actually very good this week. Except for the fact that there were some audio problems, the newscasters could help by not cutting off the newscasters' and not having alot of extra space most of the activities that they filmed editing, smooth running.
The newscasters could have stepped up a little more, they could have put the mics low in their laps; they also could have pronounced some of the words better.
I like the way the credits were arranged I also liked the way the transitions were smooth.

Tools and Techniques for Working With Others

The student works with others to complete a task; that is, the student:

- **reaches agreement with group members on what work needs to be done to complete the task and how the work will be tackled;**
- **takes a share of the responsibility for the work;**
- **consults with group members regularly during the task to check on progress in completing the task, to decide on any changes that are required, and to check that all parts have been completed at the end of the task.**

There is limited evidence to support this part of Tools and Techniques for Working With Others. The student writing in **Item D** uses the first person plural both to describe both how the work happens and to suggest ideas for the future of the production; for example, "We changed alot [sic] of things about the news since I began...We feel for the future we will need...." **Item D** also provides evidence of a formal division of responsibility: "If it is your week to film, you have to edit as well"; as does **Item E**: "I being a person on the camera crew...." **Item E** provides further insight, where the student refers to "Monday, (the day of the Lights, Camera, Action meeting)."

The students working on this project manage to bring a newscast to screen each week. In spite of the limited evidence, it is clear that the production could not rest in the hands of one or two students, and it is unlikely that the students involved could maintain this schedule if they had not learned to work with others. Given the ongoing nature of the project, this level of demand for working with others is at the upper end of expectations for the elementary school level.

The students' writing in **Items D**, **E**, and **F** contains some errors,including spelling errors (such as "alot" and "prononce"). The work was produced to inform discussion of the production and was not revised for publication.

Young children in Ontario are expected to "know how to obtain information in a variety of ways and from a variety of sources; understand different ways of organizing, analyzing, interpreting, and storing information; be able to convey information orally and in writing, as well as through other communication media (such as computers); be able to propose alternative solutions to problems."

The Common Curriculum, Grades 1-9, "Functioning in the Age of Information", outcomes for elementary school.

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Work Sample & Commentary: *The Young Authors' Conference*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

The work presented from this project is not a comprehensive record of all work done as part of the project. This is partly because the project was not done with a view to providing evidence of these standards and partly because it would be neither reasonable nor appropriate to ask students to keep detailed written records of every aspect of every project. This would defeat part of the purpose of Applied Learning, which is for students to learn from projects that have strong links to the world of work. Some of these standards better lend themselves to assessment through observation and other less formal methods than through written work.

Accordingly, the range and depth of evidence on which to base commentary related to the standards varies throughout this work sample.

Applied Learning required by the task

Students who frequently engage in reading and writing workshops sit "in the author's chair" and present their writing to the class. This experience influenced, in part, the genesis of an annual event in which third grade students sponsor a one-day authors' conference for other elementary students in their school district.

Each year the conference reflects the interests and ideas of the current group. For example, the 1994 group set up a pre-conference hot line, arranged for two professional writers to give the conference participants advice on producing effective writing, and for four accomplished storytellers to entertain them. In addition, there were small group "learning sessions" that provided in-depth exploration of successful writing strategies and "sharing sessions" that provided occasion for students to read their original stories and exchange extra copies of their books with other young authors.

Circumstances of performance

The teacher served when necessary as advisor and facilitator, in order to ensure that content objectives were met.

The students had a budget which they supplemented by selling books by the two authors as well as t-shirts the students had designed, which displayed the conference logo. The profits from the conference funded a field trip related to another class project.

This project gave students the opportunity to provide evidence related to the following parts of the Applied Learning standards:

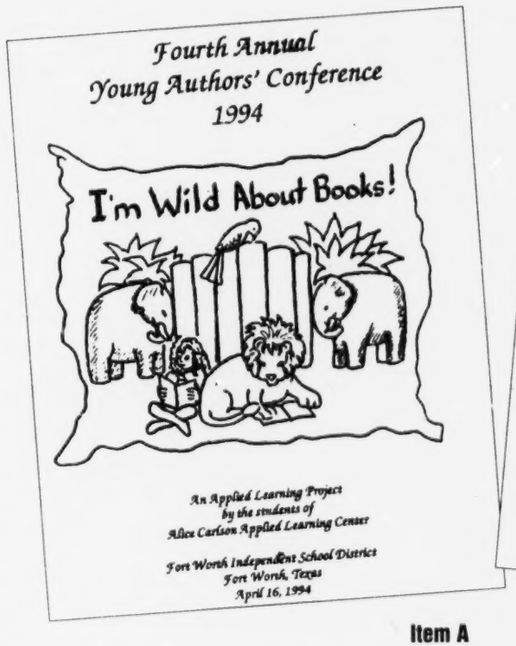
Standard 1, Problem Solving—planning and organizing;

Standard 2, Communication Tools and Techniques—composes and sends correspondence; writes and formats information for short publications;

Standard 3, Information Technology Tools and Techniques—uses word processing, graphics, and drawing programs;

Standard 4, Learning and Self-management Tools and Techniques—keeps records of work activities in an orderly manner; identifies strengths and weaknesses in his or her own work;

Standard 5, Tools and Techniques for Working With Others—works with others to complete a task.


Fourth Annual
Young Authors' Conference
1994

I'm Wild About Books!

An Applied Learning Project
by the students of
Alice Carlson Applied Learning Center

Fort Worth Independent School District
Fort Worth, Texas
April 16, 1994

Item A

2,000 hear authors, stories at event students organized

By Bob Mahlburg

About 2,000 grade school kids, parents and teachers gathered in Fort Worth for a Young Authors' Conference yesterday to hear writing tips from two authors and tales from a series of storytellers.

"It's fun to listen to them," said third-grader Dana B, a student at the Alice E. Carlson Applied Learning Center who helped plan the event.

Featured authors included children's books writers Caroline Arnold of Los Angeles and Deborah Dennard of Fort Worth.

Dana said she's a big fan of Dennard's books, particularly *Does a Cat Have Nine Lives?* and *Can Elephants Drink Through Their Noses?*

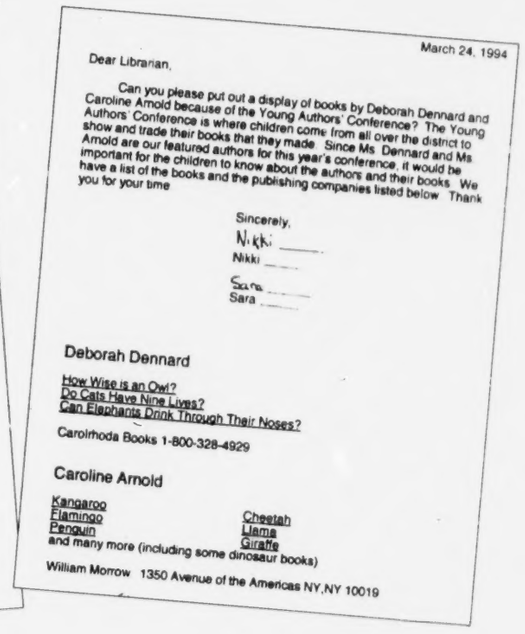
"They are pretty funny," said Storytelling Association, included one who spins African folk tales, one who incorporates music in stories and a bilingual Spanish storyteller, she said.

"The all-day conference was completely planned by students," said Alice E. Carlson teacher Deborah. "The children have just done an incredible job."

In planning the conference, students learned how to write and edit on computer and they used math to budget expenses.

The annual event was held at Paschal High School, alma mater of writers including novelist Dan Jenkins, because it was too large for any grade school, said

Item B


March 24, 1994

Dear Librarian,

Can you please put out a display of books by Deborah Dennard and Caroline Arnold because of the Young Authors' Conference? The Young Authors' Conference is where children come from all over the district to show and trade their books that they made. Since Ms. Dennard and Ms. Arnold are our featured authors for this year's conference, it would be important for the children to know about the authors and their books. We have a list of the books and the publishing companies listed below. Thank you for your time.

Sincerely,
Nikki
Nikki
Sara
Sara

Deborah Dennard

How Wise is an Owl?
Do Cats Have Nine Lives?
Can Elephants Drink Through Their Noses?

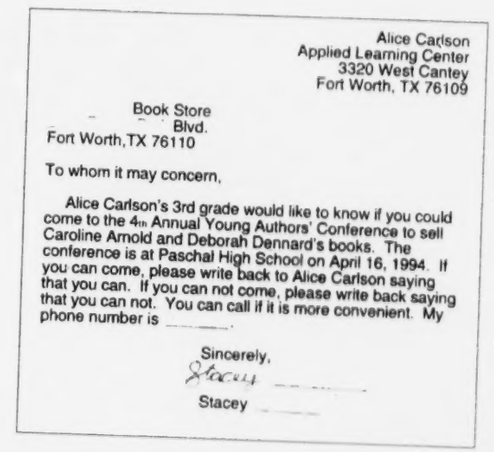
Carolrhoda Books 1-800-328-4929

Caroline Arnold

Kangaroo
Flamingo
Penguin
Cheetah
Llama
Giraffe
and many more (including some dinosaur books)

William Morrow 1350 Avenue of the Americas NY,NY 10019

Item C


Alice Carlson
Applied Learning Center
3320 West Cantey
Fort Worth, TX 76109

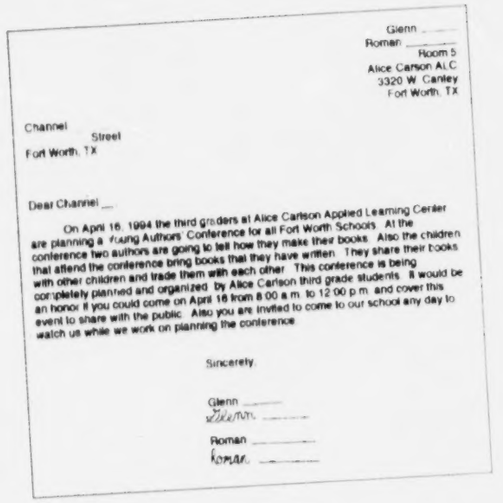
Book Store
Blvd.
Fort Worth,TX 76110

To whom it may concern,

Alice Carlson's 3rd grade would like to know if you could come to the 4th Annual Young Authors' Conference to sell Caroline Arnold and Deborah Dennard's books. The conference is at Paschal High School on April 16, 1994. If you can come, please write back to Alice Carlson saying that you can. If you can not come, please write back saying that you can not. You can call if it is more convenient. My phone number is _____.

Sincerely,
Stacey
Stacey

Item D


Glenn
Roman
Room 5
Alice Carlson ALC
3320 W. Cantey
Fort Worth, TX

Channel
Street
Fort Worth, TX

Dear Channel

On April 16, 1994 the third graders at Alice Carlson Applied Learning Center are planning a Young Authors' Conference for all Fort Worth Schools. At the conference two authors are going to tell how they make their books. Also the children that attend the conference bring books that they have written. They share their books with other children and trade them with each other. This conference is being completely planned and organized by Alice Carlson third grade students. It would be an honor if you could come on April 16 from 8:00 a.m. to 12:00 p.m. and cover this event to share with the public. Also you are invited to come to our school any day to watch us while we work on planning the conference.

Sincerely,

Glenn
Glenn
Roman
Roman

Item E

Problem Solving—Planning and Organizing

The student plans and organizes an event or activity; that is, the student:

- **develops a plan that:**
  - **includes all the factors and variables that need to be considered;**
  - **makes sense in terms of the order in which things need to be done;**
  - **makes sense in terms of the people, time and resources available to put it into action;**
  - **is described clearly enough for someone else to use it;**
- **implements the plan;**
- **evaluates the success of the event or activity, identifying the parts of the plan that worked best and the aspects that could have been improved by better planning and organization, and proposing how the improvements could have been achieved;**
- **makes recommendations to others who might consider planning and organizing a similar event or activity.**

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While the materials shown here do not include an overall plan, there is a range of evidence for planning that took place in preparation for the conference, including: asking the librarian to mount a display of books by the invited professional authors (**Item C**); approaching a local book store to set up a stall to sell books at the conference (**Item D**); arranging for publicity (**Items B** and **E**); preparing a detailed schedule and program for the conference (**Items F** and **G**); and developing and maintaining databases (**Item H**).

As the article from the *Fort Worth Star Telegram* reports, the conference attracted more than 2000 students, parents, and teachers. The scale of the event places this project beyond usual expectations for students at elementary school level, though the success of this example indicates that it is not beyond their range.

Communication Tools and Techniques

The student composes and sends correspondence, such as thank-you letters and memos providing information; that is, the student:

- **expresses the information or request clearly;**
- **writes in a style appropriate to the purpose of the correspondence.**

The evidence includes a variety of correspondence that students prepared: the letters to the librarian, bookstore, and TV station (**Items C**, **D**, and **E**) and the handwritten letter of thanks to one of the presenters (**Item I**).

Each of these is expressed clearly and written in a style appropriate to the purpose of the correspondence, and provides evidence for the quality of work expected.

Item H refers to a range of other forms of correspondence the students produced.

The student writes and formats information for short publications, such as brochures or posters; that is, the student:

- **collects information to include in the publication;**
- **organizes the information into an appropriate form for use in the publication;**
- **checks the information for accuracy;**
- **formats the publication so that it achieves its purpose.**

The students' preparation for the conference included the production of posters (**Item A**) and a conference program (**Items A**, **F**, and **G** are excerpts). These provide evidence for the quality of work expected. In particular, the conference program presents information in a clear and direct manner, while at the same time adopting a welcoming tone.

Information Technology Tools and Techniques

The student:

- **uses word processing, graphics, and drawing programs;**

The newspaper article reports that students learned how to write and edit on a computer. The poster, brochure, and correspondence provide evidence for the quality of work expected for the use of word processing, graphics, and drawing programs.

Item H refers to "making a database on our computer." This exceeds the expectations for elementary school students.

Learning and Self-management Tools and Techniques

The student keeps records of work activities in an orderly manner; that is, the student:

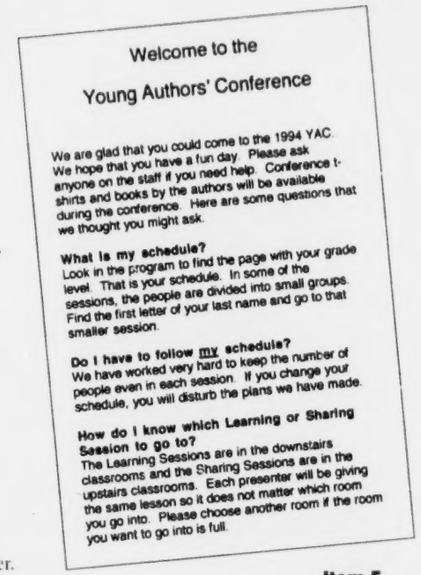
- **sets up a system for storing records of work activities;**
- **maintains records of work activities in a way that makes it possible to find specific materials quickly and easily;**

and

The student identifies strengths and weaknesses in his or her own work; that is, the student:

- **understands and establishes criteria for evaluating the quality of work processes and products;**
- **uses criteria to assess his or her own work processes and products.**

Item H provides one student's account of preparations for the conference. The account focuses on the task as a whole rather than the student's singular role, and it evaluates the activities in terms of their difficulty (for example, "One of the hardest parts was keeping organized and being responsible") rather than in terms of the students' more or less effective management of various elements of the task. Nevertheless, the account does provide evidence for a beginning analysis and review of the work.



Welcome to the

Young Authors' Conference

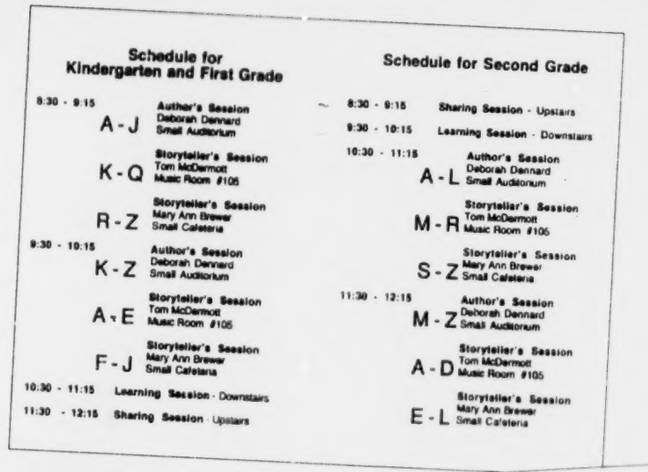
We are glad that you could come to the 1994 YAC. We hope that you have a fun day. Please ask anyone on the staff if you need help. Conference t-shirts and books by the authors will be available during the conference. Here are some questions that we thought you might ask.

What is my schedule?
Look in the program to find the page with your grade level. That is your schedule. In some of the sessions, the people are divided into small groups. Find the first letter of your last name and go to that smaller session.

Do I have to follow my schedule?
We have worked very hard to keep the number of people even in each session. If you change your schedule, you will disturb the plans we have made.

How do I know which Learning or Sharing Session to go to?
The Learning Sessions are in the downstairs classrooms and the Sharing Sessions are in the upstairs classrooms. Each presenter will be giving the same lesson so it does not matter which room you go into. Please choose another room if the room you want to go into is full.

Item F



Schedule for Kindergarten and First Grade

8:30 - 9:15
A - J Author's Session, Deborah Dennard, Small Auditorium
K - Q Storyteller's Session, Tom McDermott, Music Room #105
R - Z Storyteller's Session, Mary Ann Brewer, Small Cafeteria

9:30 - 10:15
K - Z Author's Session, Deborah Dennard, Small Auditorium
A - E Storyteller's Session, Tom McDermott, Music Room #105
F - J Storyteller's Session, Mary Ann Brewer, Small Cafeteria

10:30 - 11:15 Learning Session - Downstairs

11:30 - 12:15 Sharing Session - Upstairs

Schedule for Second Grade

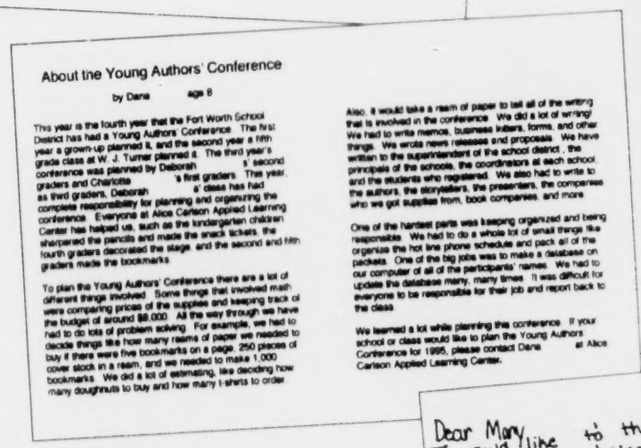
8:30 - 9:15 Sharing Session - Upstairs

9:30 - 10:15 Learning Session - Downstairs

10:30 - 11:15
A - L Author's Session, Deborah Dennard, Small Auditorium
M - R Storyteller's Session, Tom McDermott, Music Room #105
S - Z Storyteller's Session, Mary Ann Brewer, Small Cafeteria

11:30 - 12:15
M - Z Author's Session, Deborah Dennard, Small Auditorium
A - D Storyteller's Session, Tom McDermott, Music Room #105
E - L Storyteller's Session, Mary Ann Brewer, Small Cafeteria

Item G



About the Young Authors' Conference

by Dana age 8

This year is the fourth year that the Fort Worth School District has had a Young Authors' Conference. The first year a grown-up planned it, and the second year a fifth grade class at W. J. Turner planned it. The third year's conference was planned by Deborah 's second graders and Charlotte 's first graders. This year, as third graders, Deborah 's class has had complete responsibility for planning and organizing the conference. Everyone at Alice Carlson Applied Learning Center has helped us, such as the kindergarten children sharpened the pencils and made the snack tickets, the fourth graders decorated the stage, and the second and fifth graders made the bookmarks.

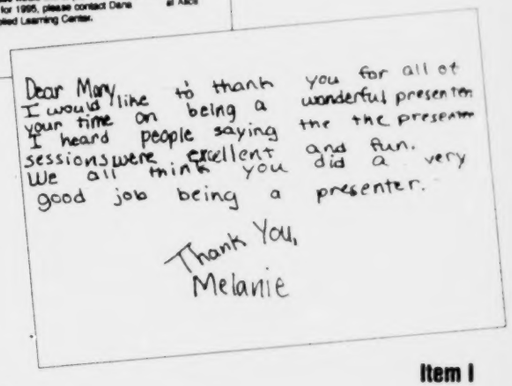
To plan the Young Authors' Conference there are a lot of different things involved. Some things that involved math were comparing prices of the supplies and keeping track of the budget of around $8,000. All the way through we have had to do lots of problem solving. For example, we had to decide things like how many reams of paper we needed to buy if there were five bookmarks on a page, 250 pieces of cover stock in a ream, and we needed to make 1,000 bookmarks. We did a lot of estimating, like deciding how many doughnuts to buy and how many t-shirts to order.

Also, it would take a ream of paper to tell all of the writing that is involved in the conference. We did a lot of writing things. We wrote news releases and proposals. We have written to the superintendent of the school district, the principals of the schools, the coordinators at each school, and the students who registered. We also had to write to the authors, the storytellers, the presenters, the companies who we got supplies from, book companies, and more.

One of the hardest parts was keeping organized and being responsible. We had to do a whole lot of small things like organize the hot line phone schedule and pack all of the packets. One of the big jobs was to make a database on our computer of all of the participants' names. We had to update the database many, many times. It was difficult for everyone to be responsible for their job and report back to the class.

We learned a lot while planning this conference. If your school or class would like to plan the Young Authors Conference for 1995, please contact Dana at Alice Carlson Applied Learning Center.

Item H



Dear Mary,
I would like to thank you for all of your time on being a wonderful presenter. I heard people saying the the presenters sessions were excellent and fun. We all think you did a very good job being a presenter.

Thank You,
Melanie

Item I

Tools and Techniques for Working With Others

The student works with others to complete a task; that is, the student:

- **reaches agreement with group members on what needs to be done to complete the task and how it will be tackled;**
- **takes a share of the responsibility for the work;**
- **consults with group members regularly during the task to check on progress in completing the task and decide on any changes that are required, and at the end of the task to check that all parts have been completed.**

Item H describes some of the organizational issues the students needed to resolve in working together to complete the task. Other evidence for this standard is available only by inference.

Making an event of this kind and magnitude happen on its scheduled day makes demands for working with others that place this project at the upper end of expectations for elementary school level.

Note that the evidence contains some editing errors; for example, in **Item D** "can not" should be spelled "cannot"; "Caroline and Deborah Dennard's books" should be "Caroline Arnold's and Deborah Dennard's books"; and "To whom it may concern" should be capitalized.

All students in Norway are expected to "experience how they function as responsible partners in contact and cooperation with adults inside and outside the schools; learn about the school community and the local environment, and share responsibility for these environments by helping to plan and implement various practical initiatives; increase their knowledge and understanding of working life and the tasks to be carried out in their own district; conserve local cultural traditions, and encourage them to share responsibility for cultural activities in the local community."

Curriculum Guidelines for Compulsory Education in Norway, p. 101.

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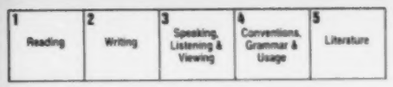
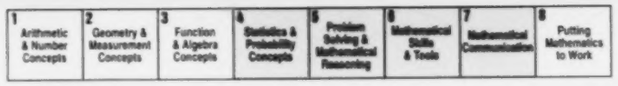
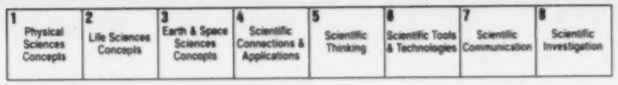
Work Sample & Commentary: *Canned Food Drive*



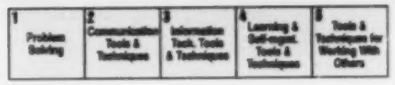
English Language Arts


1 Arithmetic & Number Concepts
2 Geometry & Measurement Concepts
3 Function & Algebra Concepts
4 Statistics & Probability Concepts
5 Problem Solving & Mathematical Reasoning
6 Mathematical Skills & Tools
7 Mathematical Communication
8 Putting Mathematics to Work

Mathematics


1 Physical Sciences Concepts
2 Life Sciences Concepts
3 Earth & Space Sciences Concepts
4 Scientific Connections & Applications
5 Scientific Thinking
6 Scientific Tools & Technologies
7 Scientific Communication
8 Scientific Investigation

Science


1 Problem Solving
2 Communication Tools & Techniques
3 Information Tech. Tools & Techniques
4 Learning & Self-mgmt. Tools & Techniques
5 Tools & Techniques for Working With Others

Applied Learning

The work presented from this project is not a comprehensive record of all work done as part of the project. This is partly because the project was not done with a view to providing evidence of these standards and partly because it would be neither reasonable nor appropriate to ask students to keep detailed written records of every aspect of every project. This would defeat part of the purpose of Applied Learning, which is for students to learn from projects that have strong links to the world of work. Some of these standards better lend themselves to assessment through observation and other less formal methods than through written work.

Accordingly, the range and depth of evidence on which to base commentary related to the standards varies throughout this work sample.

Applied Learning and Mathematics required by the task

Students were asked: "If you were going to organize a way to collect donations for a charity that you and your parents were involved with, how would you go about it? What would you need? How would you plan it so that you could collect a lot in a pleasant manner?" They decided to run a school wide canned food drive.

An important part of the task was to keep the students and teachers updated and motivated about how their classes and the school as a whole were doing. This required the students to quickly collect, accurately calculate, and clearly organize and present the data, that is, the number of cans collected.
In order to begin the project the class needed to "formulate" the problem—in this case, to decide how to gather and disseminate data about the canned food drive. They collected data, used a computer to organize it in a spreadsheet, and represented current totals in the form of bar graphs and graphics, both hand drawn and computer generated. Finally, in order to succeed in gathering the greatest number of cans within the given two weeks, they needed to keep in mind both their purpose and audience, conveying urgency and excitement, without sacrificing accuracy or clarity of communication.

Circumstances of performance

The students had two weeks to plan for the drive, which was conducted over a two week period. The teacher assisted the students in brainstorming and initial planning stages. Students formed groups for different tasks, and while each student was to perform calculations, groups of students were encouraged to use a computer spreadsheet to help with the mathematics. The students needed to obtain permission from school officials to run the canned food drive.

This project gave students the opportunity to provide evidence related to the following parts of the Applied Learning and Mathematics standards:

Applied Learning Standard 1, Problem Solving—planning and organizing;

Applied Learning Standard 2, Communication Tools and Techniques—composes and sends correspondence; writes and formats information for short publications; translates information from one format to another;

Applied Learning Standard 3, Information Technology Tools and Techniques—uses word processing, graphics, and drawing programs;

Applied Learning Standard 4, Learning and Self-management Tools and Techniques—learns from role models; identifies strengths and weaknesses in his or her own work;

Applied Learning Standard 5, Tools and Techniques for Working With Others—works with others to complete a task;

Mathematics Standard 4, Statistics and Probability Concepts—displays data in graphs, tables, and charts;

Mathematics Standard 5, Problem Solving and Reasoning;

Mathematics Standard 6, Mathematical Skills and Tools;

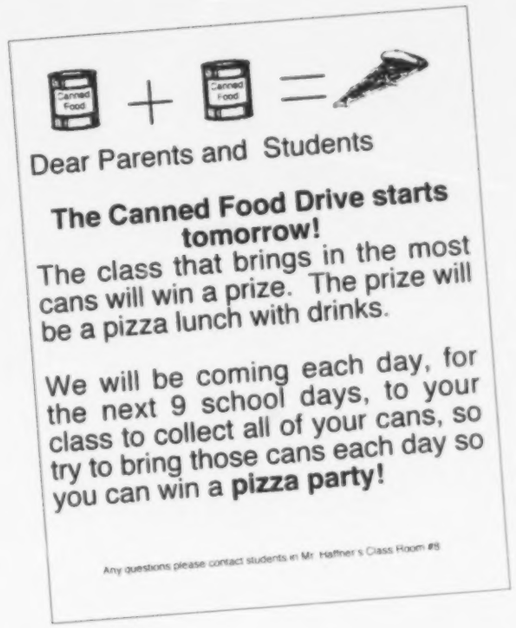
Mathematics Standard 7, Mathematical Communication.

Applied Learning

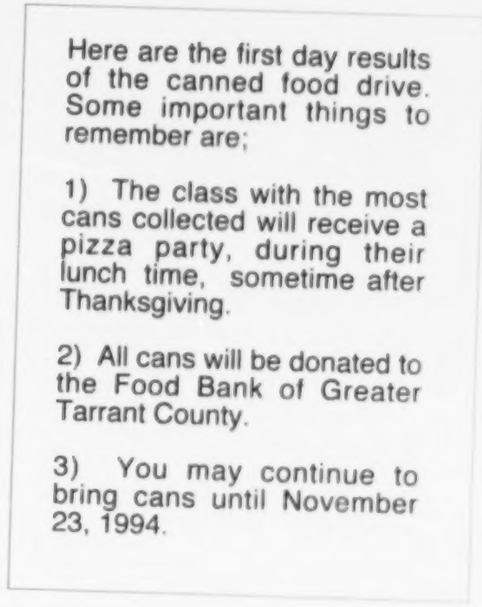
Problem Solving—Planning and Organizing

The student plans and organizes an event or activity; that is, the student:

- **develops a plan that:**
  - **includes all the factors and variables that need to be considered;**
  - **makes sense in terms of the order in which things need to be done;**
  - **makes sense in terms of the people, time, and resources available to put the plan into action;**
  - **is described clearly enough for someone else to use it;**
- **implements the plan;**
- **evaluates the success of the event or activity, identifying the parts of the plan that worked best and the aspects that could have been improved by better planning and organization, and proposing how the improvements could have been achieved;**
- **makes recommendations to others who might consider planning and organizing a similar event or activity.**


Canned Food
Canned Food
Dear Parents and Students
The Canned Food Drive starts tomorrow!
The class that brings in the most cans will win a prize. The prize will be a pizza lunch with drinks.
We will be coming each day, for the next 9 school days, to your class to collect all of your cans, so try to bring those cans each day so you can win a pizza party!
Any questions please contact students in Mr. Haffner's Class Room #8

Item A


Here are the first day results of the canned food drive. Some important things to remember are;
1) The class with the most cans collected will receive a pizza party, during their lunch time, sometime after Thanksgiving.
2) All cans will be donated to the Food Bank of Greater Tarrant County.
3) You may continue to bring cans until November 23, 1994.

Item B

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There is no evidence of the plan the students prepared for the canned food drive nor of the process by which they arrived at it, other than information provided from the teacher that students looked at various marketing techniques during the planning stage and sought advice from experts and parents in the business field.

Evidence of implementation of the plan includes a guide for making phone calls to solicit donations for the prize to the winning class and a range of material prepared for advertising and record keeping purposes: the poster (**Item A**) advertising the beginning of the drive; the memo reporting the first day results and urging students to maintain momentum; and charts and tables prepared by students to track the project on a daily basis.

There is no evidence of the students' evaluation of the success of the activity nor of any recommendations they may have made for subsequent activities. The project required students to obtain permission from the principal; initiate contact by telephone with local businesses for the purpose of obtaining donations for prizes; announce and advertise the drive to everyone in the school; maintain the collection over a two week period; keep accurate and up to date records; and arrange for the donation of canned goods to reach its destination. The project was not complicated in concept, but taking responsibility for maintaining the collection over a two week period and running it as a competition with a prize makes it illustrative of the level of demand expected of students at the elementary school level.

Communication Tools and Techniques

The student composes and sends correspondence, such as thank-you letters and memos providing information; that is, the student:

- **expresses the information or request clearly;**
- **writes in a style appropriate to the purpose of the correspondence.**

Item B is a memo accompanying the announcement of the first day's results. It expresses the information clearly and in a style appropriate to a memo of this kind.

The student writes and formats information for short publications, such as brochures or posters; that is, the student:

- **collects information to include in the publication;**
- **organizes the information into an appropriate form for use in the publication;**
- **checks the information for accuracy;**
- **formats the publication so that it achieves its purpose.**

Items C and **D** are examples of posters prepared to advertise current leaders in the competition. The posters reflect consideration of ways of capturing attention not only in the simplicity with which the information is presented but the attention given to format and the language selected, including use of a play on words.

These samples provide evidence for the quality of work expected of students at the elementary school level.

The student translates information from one format to another; that is, the student:

- **chooses a different format that is appropriate for presenting information to better suit the purpose for communicating it;**
- **checks that the information has been translated accurately into the new format;**
- **gives reasons for any changes made in the information, such as deciding to leave some information out.**

The students translated the running totals from a spreadsheet to a bar graph for the purpose of reporting progressive results and highlighting which classes were competing for the lead. The information is translated accurately. Translating data from tables to graphs is an appropriate task for students at the elementary level.

There is no information available to indicate whether the students considered alternative formats before choosing to use a bar graph or whether they considered modifying the information in any way.

Information Technology Tools and Techniques

The student:

- **uses word processing, graphics, and drawing programs.**

The work provides evidence for the quality of work expected at the elementary school level. The use of spreadsheets is not expected until middle school.

Item C

Item D

Overall leaders as of
11-17-1994

1st Sanchez
2nd Robinson
3rd Gerwick

KEEP THE CANS COMING!

Leaders by Grade Level as of
11-17-1994

K Donaldson
1st Grade Lawrence
2nd Grade Ignacio
3rd Grade Gerwick
4th Grade Robinson
5th Grade Sanchez

Donation Phone Call Guide

This is _____ from Alice Carlson Applied Learning Elementary School. Our 3rd grade class is sponsoring the can food drive for our school. We are planning to have a pizza party for the class that brings the most cans. The cans will be donated to the Food Bank of Greater Tarrant County. We were wondering if you would be able to donate enough pizza for the winning class.

Item E

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Work Sample & Commentary: *Canned Food Drive continued*

1 Reading	2 Writing	3 Speaking, Listening & Viewing	4 Conventions, Grammar & Usage	5 Literature

English Language Arts

1 Arithmetic & Number Concepts	2 Geometry & Measurement Concepts	3 Function & Algebra Concepts	4 Statistics & Probability Concepts	5 Problem Solving & Mathematical Reasoning	6 Mathematical Skills & Tools	7 Mathematical Communication	8 Putting Mathematics to Work

Mathematics

1 Physical Sciences Concepts	2 Life Sciences Concepts	3 Earth & Space Sciences Concepts	4 Scientific Connections & Applications	5 Scientific Thinking	6 Scientific Tools & Technologies	7 Scientific Communication	8 Scientific Investigation

Science

1 Problem Solving	2 Communication Tools & Techniques	3 Information Tech. Tools & Techniques	4 Learning & Self-mgmt. Tools & Techniques	5 Tools & Techniques for Working With Others

Applied Learning

The quotations from the Mathematics performance descriptions in this commentary are excerpted. The complete performance descriptions are shown on pages 38-39.

Learning and Self-management Tools and Techniques

The student learns from role models; that is, the student:

- **consults with or observes older students and adults at work and identifies the main features of what they do, the way they go about their work, and the qualities of the products they produce;**
- **takes account of role models in planning and conducting his or her own project activities.**

The teacher involved with this project reported that the students looked at various marketing techniques and sought advice from experts and parents in the business field. There is no evidence, however, of the ways in which the students used this information to inform their planning and implementation of the project.

The student identifies strengths and weaknesses in his or her own work; that is, the student:

- **understands and establishes criteria for judging the quality of work processes and products;**
- **assesses his or her own work processes and products.**

Item I is the list of criteria the students developed for evaluating the quality of their work on spreadsheets. There is no evidence for the way the students used the criteria to assess their work.

Tools and Techniques for Working With Others

The student works with others to complete a task; that is, the student:

- **reaches agreement with group members on what work needs to be done to complete the task and how the work will be tackled;**
- **takes a share of the responsibility for the work;**
- **consults with group members regularly during the task to check on progress in completing the task, to decide on any changes that are required, and to check that all parts have been completed at the end of the task.**

There is no direct evidence for how the students approached the task of working with others. The teacher reported that the students organized themselves into sub-groups, each with a specific responsibility: advertising, collection, tracking and reporting results, and communications. It can be inferred that the project would have required regular communication among the sub-groups and checking that all parts of the work had been completed satisfactorily.

The demands of the project for working with others illustrate the expectations for elementary school level.

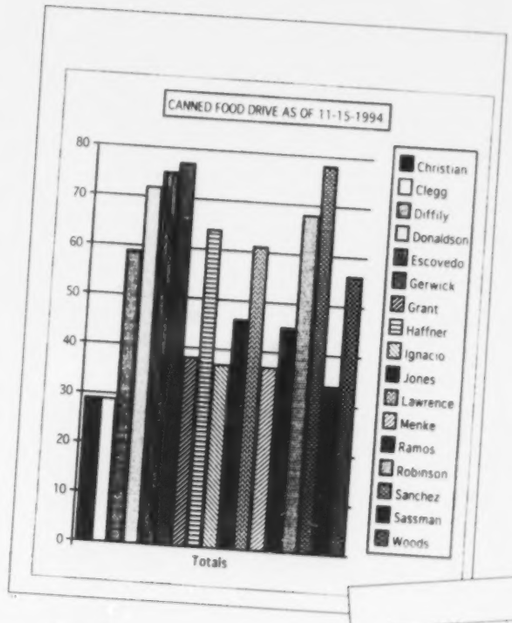
Mathematics

Statistics and Probability Concepts

The project illustrates this part of the standard for Statistics and Probability Concepts:

- **displays data in graphs, tables, and charts.**

Each part of the work—collecting the daily raw data, organizing it into spreadsheets via computer, and displaying it in various forms—was carried out with the agreed upon purpose (to provide feedback and motivation) and audience in mind.



Item F

TEACHER	11/10	11/14	11/15	11/16	11/17	11/18	11/21	11/22	Totals
D**y	7	21	31	21	12	11	4	79	186
Donaldson	57	6	9	25	11	19	14	16	157
Escovedo	33	24	18	13	0	6	7	0	101
Totals	97	51	58	59	23	36	25	95	444

Item G

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Problem Solving and Mathematical Reasoning

The student participates in the formulation of problems; that is, given the basic statement of a problem situation, the student:

- **makes decisions about the approach, materials, and strategies to use;**
- **uses previously learned strategies, skills, knowledge, and concepts to make decisions;**
- **uses strategies, such as using manipulatives or drawing sketches, to model problems;**
- **does not merely fill in a given chart, use a pre-specified manipulative or go through a predetermined set of steps.**

This work provides evidence for problem formulation. The students were required to make decisions about how to organize a school wide fund raiser and formulate successful approaches to accomplish this purpose.

Mathematical Skills and Tools

The work provides evidence for the quality of work expected for the following parts of Mathematical Skills and Tools:

- **adds;**
- **reads, creates, and represents data on charts, tables, diagrams, bar graphs;**
- **uses computers to achieve solutions.**

Students used these skills and tools to provide clearly presented information for the food drive's participants and to determine the winner.

Mathematical Communication

Finally, the way the class represented the data that they collected in a number of ways provides evidence for the quality of work expected for these parts of Mathematical Communication:

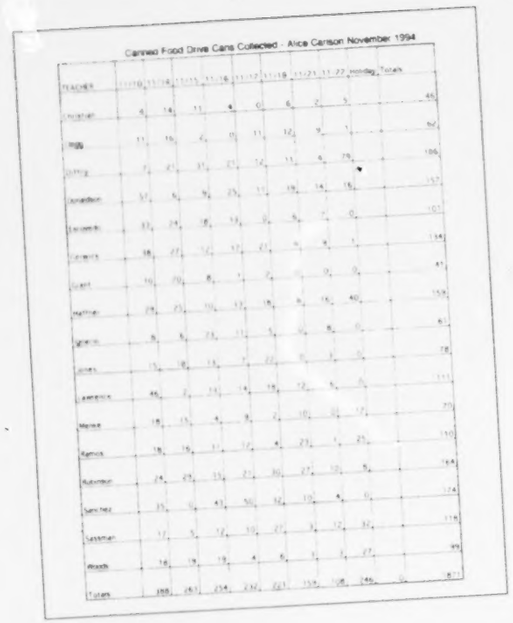
- **shows ideas in a variety of ways, including words, numbers, symbols, pictures, charts, graphs, tables, diagrams, and models;**
- **considers purpose and audience when communicating.**

Other comments

In a project of this kind, some ways of representing data are more effective than others. It would be interesting to know how decisions (and revisions) were made about what kind of graphic or graph to use for which audience. For example, is showing school wide data in a bar graph that contains 17 bars and an attached key the best way to convey this information? What other representations are possible? Which would be better for this purpose and why? Do teachers need different information from students?

While it is valuable for students to use spreadsheet software to organize large amounts of data, it might also be valuable and interesting to see how the students would deal with this mass of data themselves, in the form of their own charts and tables (as was done with bar graphs).

The use of a semicolon instead of a colon and the overuse of commas in the run-on sentence are noticeable errors in the first day's results.


Canned Food Drive Cans Collected - Alice Carlson November 1994

Item H

Rubric for spreadsheet of cans collected for Grade level

4 - Done as a spreadsheet and not just a sheet of numbers
- Notably done - Very readable and understandable by anyone, even if they are not aware of what we are doing
- Math calculations are all correct and accurate
- You are able to understand the information you have on your spreadsheet in that you can pull specific answers out of it consistently

Page 5

Item I

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APPENDIX 1

The elementary school standards are set at a level of performance approximately equivalent to the end of fourth grade. The middle school standards are set at a level of performance approximately equivalent to the end of eighth grade. The high school standards are set at a level of performance approximately equivalent to the end of tenth grade. It is expected that some students might achieve these levels earlier and others later than these grades.

An array of work is required to achieve any single standard. The work becomes increasing refined and sophisticated as students get older. The complexity of the tasks used to generate the work also increases. This notion of requiring students to hone the sophistication of their performances while simultaneously working with increasingly complex assignments cuts across all the English Language Arts standards.

The number of books required to meet this standard does not increase as students get older, but the length and complexity of what is read does increase, so, this standard becomes increasingly formidable.

The reading requirement assumes an adequate library of appropriate reading material. In some places, library resources are too meager to support the amount of reading required for every student to achieve this standard. Where a shortage of books exists, better use of out-of-school resources must be made; for example, students may have to be assured access to local or county libraries.

Reading twenty-five books a year entails a substantial amount of time. Students may use materials read in conjunction with their regular class work, including courses other than English, to satisfy this requirement.

ELEMENTARY SCHOOL

The student reads and comprehends material of the quality and complexity illustrated in the sample reading list equivalent to twenty-five books each year. The materials should include traditional and contemporary children's literature or the equivalent in children's magazines, newspapers, textbooks, and media, from at least three different literary forms and from at least five different writers. The student produces evidence of reading that:

- demonstrates a thorough understanding of the text as a whole;
- identifies complexities presented in the text, i.e., ideas, information, levels of meaning;
- extracts salient information from the text;
- uses paraphrasing judiciously.

The student reads in depth at least four books (or book equivalents) about one issue or subject, or four books by a single writer, or four books in one genre, and produces evidence of reading that:

- makes and supports warranted and responsible assertions about the texts;
- supports assertions with elaborated and convincing evidence;
- makes perceptive and well developed connections;
- evaluates writing strategies and elements of the author's craft.

The student reads informational materials to develop understanding and expertise and produces written or oral work that:

- restates or summarizes information;
- relates new information to prior knowledge and experience;
- extends ideas;
- makes connections to related topics or information.

The student reads aloud, accurately (in the range of 85-90%), familiar material of the quality and complexity illustrated in the sample reading list, and in a way that makes meaning clear to listeners by:

- self correcting when subsequent reading indicates an earlier miscue;
- using a range of cueing systems, e.g., phonics and context clues, to determine pronunciation and meanings;
- reading with a rhythm, flow, and meter that sounds like everyday speech.

MIDDLE SCHOOL

The student reads and comprehends material of the quality and complexity illustrated in the sample reading list equivalent to twenty-five books each year. The materials should include traditional and contemporary literature or the equivalent in magazines, newspapers, textbooks, and media, from at least three different literary genres and from at least five different writers. The student produces evidence of reading that:

- demonstrates a thorough understanding of the text as a whole;
- identifies complexities presented in the text, i.e., ideas, information, levels of meaning;
- extracts salient information from the text;
- uses paraphrasing judiciously.

The student reads in depth at least four books (or book equivalents) about one issue or subject, or four books by a single writer, or four books in one genre, and produces evidence of reading that:

- makes and supports warranted and responsible assertions about the texts;
- supports assertions with elaborated and convincing evidence;
- makes perceptive and well developed connections;
- evaluates writing strategies and elements of the author's craft.

The student reads informational materials to develop understanding and expertise and produces written or oral work that:

- restates or summarizes information;
- relates new information to prior knowledge and experience;
- extends ideas;
- makes connections to related topics or information.

The student demonstrates familiarity with a variety of public documents and produces written or oral work that:

- identifies the author's purpose and stance;
- analyzes the arguments and positions advanced and the evidence offered in support of them;
- identifies common persuasive techniques.

The student demonstrates familiarity with a variety of functional documents and produces written or oral work that:

- identifies the sequence of activities needed to carry out a procedure;
- analyzes the formatting techniques used to make a document user-friendly;
- identifies any information that is either extraneous or missing.

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HIGH SCHOOL

The student reads and comprehends material of the quality and complexity illustrated in the sample reading list equivalent to twenty-five books each year. The materials should include traditional and contemporary literature or the equivalent in magazines, newspapers, textbooks, and media, from at least three different literary genres and from at least five different writers. The student produces evidence of reading that:

- demonstrates a thorough understanding of the text as a whole;
- identifies complexities presented in the text, i.e., ideas, information, levels of meaning;
- extracts salient information from the text;
- uses paraphrasing judiciously.

The student reads in depth at least four books (or book equivalents) about one issue or subject, or four books by a single writer, or four books in one genre, and produces evidence of reading that:

- makes and supports warranted and responsible assertions about the texts;
- supports assertions with elaborated and convincing evidence;
- makes perceptive and well developed connections;
- evaluates writing strategies and elements of the author's craft.

The student reads informational materials to develop understanding and expertise and produces written or oral work that:

- restates or summarizes information;
- relates new information to prior knowledge and experience;
- extends ideas;
- makes connections to related topics or information.

6. Public Documents

The student produces at least one public document, in which the writer:

- exhibits an awareness of the importance of precise word choice and the power of imagery and/or anecdote;
- utilizes and recognizes the power of logical arguments, arguments based on appealing to a reader's emotions, and arguments dependent upon the writer's persona;
- uses arguments that are appropriate in terms of the knowledge, values, and degree of understanding of the intended audience;
- uses a range of strategies to appeal to readers.

The student critiques at least one public document, with an eye to strategies common in public discourse, including:

- effective use of argument;
- use of the power of anecdote;
- anticipation of counter claims;
- appeal to audiences both friendly and hostile to the position presented;
- use of emotionally laden words and imagery;
- citing of appropriate references or authorities.

7. Functional Documents

The student produces at least one functional document, appropriate to audience and purpose, in which the writer:

- reports, organizes, and conveys information and ideas accurately;
- includes relevant narrative details, such as scenarios, definitions, examples;
- anticipates readers' problems, mistakes, and misunderstandings;
- uses a variety of formatting techniques, including headings, subordinate terms, foregrounding of main ideas, hierarchical structures, graphics, and color;
- establishes a persona that is consistent with the document's purpose;
- employs word choices that are consistent with the persona and appropriate for the intended audience.

The student critiques at least one functional document, with an eye to strategies common to good functional documents, including:

- visual appeal, e.g., format, graphics, white space, headers;
- logic of the sequence in which the directions are given;
- awareness of possible reader misunderstandings.

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ELEMENTARY SCHOOL

Fiction:
Brink, *Caddie Woodlawn*;
Cleary, *Ramona and Her Father*;
Coerr, *The Josefina Story Quilt*;
Cohen, *Fat Jack*;
De Saint-Exupery, *The Little Prince*;
Hamilton, *Zeely*;
Hansen, *The Gift-Giver*;
Lord, *In the Year of the Boar and Jackie Robinson*;
Mendez and Byard, *The Black Snowman*;
Naidoo, *Journey to Jo'Burg*;
O'Dell, *Zia*;
Ringgold, *Tar Beach*;
Speare, *The Sign of the Beaver*;
Yep, *Child of the Owl*.

Non-Fiction:
Aliki, *Corn Is Maize: The Gift of the Indians*;
Baylor, *The Way to Start a Day*;
Cherry, *The Great Kapok Tree*;
Epstein, *History of Women in Science for Young People*;
Greenfield, *Childtimes: A Three-Generation Memoir*;
Godkin, *Wolf Island*;
Hamilton, *Anthony Burns: The Defeat and Triumph of a Fugitive Slave*;
McKissack, *Frederick Douglass: The Black Lion*;
Politi, *Song of the Swallows*;
Sattler, *Dinosaurs of North America*;
Fritz, *And Then What Happened, Paul Revere?*;
McGovern, *The Secret Soldier: The Story of Deborah Sampson*.

Poetry:
Ahlberg, *Heard It in the Playground*;
Blishen and Wildsmith, *Oxford Book of Poetry for Children*;
De Regniers, Moore, White, and Carr, eds., *Sing a Song of Popcorn*;
Giovanni, *Ego-Tripping and Other Poems for Young People*;
Greenfield, *Honey, I Love and Other Love Poems*;
Heard, *For the Good of the Earth and Sun*;
Janeczko, *Strings: A Gathering of Family Poems*;
Koch and Farrell, eds., *Talking to the Sun*;
Lobel, ed., *The Random House Book of Mother Goose*;
Manguel, ed., *Seasons*;
Mathis, *Red Dog, Blue Fly: Football Poems*;
Silverstein, *Where the Sidewalk Ends*.

Folklore:
Griego y Maestas, *Cuentos: Tales From the Hispanic Southwest*;
French, *Snow White in New York*;
Huck and Lobel, *Princess Furball*;
Louie and Young, *Yeh-Shen: A Cinderella Story From China*;
Luenn, *The Dragon Kite*;
Goble, *Buffalo Woman*;
Steptoe, *Mufaro's Beautiful Daughters*;
Steptoe, *The Story of Jumping Mouse*;
Kipling, *The Elephant's Child*;
Lee, *Legend of the Milky Way*.

Modern Fantasy and Science Fiction:
Andersen, *The Ugly Duckling*;
Bond, *A Bear Called Paddington*;
Dahl, *James and the Giant Peach*;
Grahame, *The Wind in the Willows*;
Lewis, *The Lion, The Witch and The Wardrobe*;
Norton, *The Borrowers*;
Van Allsburg, *Jumanji*;
White, *Charlotte's Web*.

Children's magazines:
Weekly Reader;
Creative Classroom;
Social Studies for the Young Learner;
World (National Geographic);
News (Scholastic);
Action (Scholastic);
Local newspapers or their equivalents.

Other: Manuals appropriate for elementary school children, e.g., Nintendo, other computer manuals.

MIDDLE SCHOOL

Fiction:
Anaya, *Bless Me, Ultima*;
Armstrong, *Sounder*;
Bonham, *Durango Street*;
Cohen, *Tell Us Your Secret*;
Collier, *My Brother Sam Is Dead*;
Cormier, *I Am the Cheese*;
Danziger, *The Cat Ate My Gymsuit*;
Fast, *April Morning*;
Gaines, *A Gathering of Old Men*;
Goldman, *The Princess Bride*;
Greene, *Summer of My German Soldier*;
Hansen, *Which Way Freedom*;
Hinton, *The Outsiders*;
Holman, *Slake's Limbo*;
London, *The Call of the Wild*;
Mathis, *Listen for the Fig Tree*;
Mohr, *Nilda*;
Neufeld, *Lisa, Bright and Dark*;
O'Brien, *Z for Zachariah*;
Reiss, *The Upstairs Room*;
Schaefer, *Shane*;
Stevenson, *Treasure Island*;
Voigt, *Dicey's Song*;
Walker, *To Hell With Dying*;
Walter, *Because We Are*;
Zindel, *The Pigman*.

Non-Fiction:
Amory, *The Cat Who Came for Christmas*;
Berck, *No Place to Be: Voices of Homeless Children*;
Frank, *The Diary of a Young Girl*;
George, *The Talking Earth*;
Gilbreth, *Cheaper by the Dozen*;
Haskins, *Outward Dreams*;
Hautzig, *Endless Steppe: A Girl in Exile*;
Herriott, *All Creatures Great and Small*;
Lester, *To Be a Slave*;
Meyers, *Pearson, a Harbor Seal Pup*;
Soto, *Living Up the Street*;
White, *Ryan White: My Own Story*;
Yates, *Amos Fortune, Free Man*.

Poetry:
Adams, *Poetry of Earth and Sky*;
Eliot, *Old Possum's Book of Practical Cats*;
Frost, *You Come Too*;
Greenfield, *Night on Neighborhood Street*;
Livingston, *Cat Poems*.

Drama:
Blinn, *Brian's Song*;
Davis, *Escape to Freedom*;
Gibson, *The Miracle Worker*;
Lawrence and Lee, *Inherit the Wind*;
Osborn, *On Borrowed Time*;
Shakespeare, *A Midsummer Night's Dream*;
Stone, *Metamora, or, the Last of the Wampanoags*.

Folklore/Mythology:
Blair, *Tall Tale America*;
Bruchac, *The First Strawberries: A Cherokee Story*;
Bryan, *Beat the Story-Drum, Pum-Pum*;
D'Aulaire, *Norse Gods and Giants*;
Gallico, *The Snow Goose*;
Lee, *Toad Is the Uncle of Heaven: A Vietnamese Folk Tale*;
Pyle, *Merry Adventures of Robin Hood*.

Modern Fantasy and Science Fiction:
Bradbury, *Dandelion Wine*;
Babbitt, *Tuck Everlasting*;
Cooper, *The Grey King*;
Hamilton, *The Magical Adventures of Pretty Pearl*;
L'Engle, *A Wrinkle in Time*;
Tolkien, *The Hobbit*;
Yep, *Dragon of the Lost Sea*.

Magazines/Periodicals:
Scope (Scholastic);
World (National Geographic);
Junior Scholastic (Scholastic);
Science World (Scholastic);
Cobblestone (American history);
Calliope (world history);
Faces (anthropology);
Odyssey (science).

Other: Computer manuals; instructions; contracts. See also the reading lists included in award books corresponding to reading provided by the Girl Scouts of America and the Boy Scouts of America.

HIGH SCHOOL

Fiction:
Brito, *The Devil in Texas*;
Carroll, *Alice in Wonderland*;
Cisneros, *The House on Mango Street*;
Clark, *The Ox-Bow Incident*;
Golding, *Lord of the Flies*;
Hawthorne, *The Scarlet Letter*;
Hemingway, *For Whom the Bell Tolls*;
Hentoff, *The Day They Came to Arrest the Book*;
Hilton, *Goodbye, Mr. Chips*;
Kinsella, *Shoeless Joe*;
Knowles, *A Separate Peace*;
Lee, *To Kill a Mockingbird*;
McCullers, *The Heart Is a Lonely Hunter*;
Orwell, *1984*;
Paulsen, *Canyons*;
Portis, *True Grit*;
Potok, *Davita's Harp*;
Stoker, *Dracula*;
Wartski, *A Boat to Nowhere*;
Welty, *The Golden Apples*.

Non-Fiction:
Angell, *Late Innings*;
Angelou, *I Know Why the Caged Bird Sings*;
Ashe, *Days of Grace*;
Beal, *"I Will Fight No More Forever": Chief Joseph and the Nez Perce War*;
Bishop, *The Day Lincoln Was Shot*;
Bloom, *The Closing of the American Mind*;
Campbell, *The Power of Myth*;
Covey, *Seven Habits of Highly Effective People*;
Galarza, *Barrio Boy*;
Hawking, *A Brief History of Time*;
Houston, *Farewell to Manzanar*;
Kennedy, *Profiles in Courage*;
Kingsley and Levitz, *Count Us In: Growing Up With Down Syndrome*;
Kingston, *Woman Warrior*;
Mazer, ed., *Going Where I'm Coming From*;
Momaday, *The Way to Rainy Mountain*;
Rodriquez, *Hunger of Memory*;
Sternberg, *User's Guide to the Internet*;
Wright, *Black Boy*.

Poetry:
Angelou, *I Shall Not be Moved*;
Bly, ed., *News of the Universe*;
Cummings, *Collected Poems*;
Dickinson, *Complete Poems*;
Randall, ed., *The Black Poets*;
Carruth, ed., *The Voice That Is Great Within Us*;
Hughes, *Selected Poems*;
Knudson and Swenson, eds., *American Sports Poems*;
Longfellow, *Evangeline*;
Wilbur, *Things of This World*.

Drama:
Christie, *And Then There Were None*;
Hansberry, *A Raisin in the Sun*;
McCullers, *The Member of the Wedding*;
Pomerance, *The Elephant Man*;
Rose, *Twelve Angry Men*;
Rostand, *Cyrano de Bergerac*;
Shakespeare, *Romeo and Juliet*; *Julius Caesar*;
Van Druten, *I Remember Mama*;
Wilder, *The Skin of Our Teeth*;
Wilson, *The Piano Lesson*.

Folklore/Mythology:
Evslin, *Adventures of Ulysses*;
Pinsent, *Greek Mythology*;
Stewart, *The Crystal Cave*;
Burland, *North American Indian Mythology*;
White, *The Once and Future King*.

Modern Fantasy and Science Fiction:
Adams, *Watership Down*;
Asimov, *Foundation*;
Bradbury, *The Martian Chronicles*;
Clarke, *2001: A Space Odyssey*;
Clarke, *Childhood's End*;
Frank, *Alas, Babylon*;
Herbert, *Dune*;
Lewis, *Out of the Silent Planet*;
McCaffrey, *Dragonflight*;
Twain, *A Connecticut Yankee in King Arthur's Court*;
Verne, *20,000 Leagues Under the Sea*.

Magazines and Newspapers:
Omni;
Sports Illustrated;
Literary Cavalcade (Scholastic);
National Geographic;
Smithsonian;
Newsweek;
Time.

Other: Computer manuals; instructions; contracts; technical materials.

APPENDIX 1

These standards allow for oral performances of student work whenever appropriate.

Much writing can be classified as belonging to the public arena. New Standards, however, defines public documents to mean only those pieces of text that are concerned with public policy, that address controversial issues confronting the public, or that arise in response to controversial issues or public policy. Public documents are included in the Reading standard at middle school and constitute a separate standard at high school. At the middle school level, the issues students write about come primarily from the school or local community. At high school, students should address issues which are of national importance.

Functional writing is writing that exists in order to get things done. Functional writing is ordinarily considered technical writing and, as such, is often not part of the typical English curriculum. New Standards requires students to demonstrate proficiency with functional writing because such writing is of increasing importance to the complex literacy of our culture. Functional documents are included in the Reading standard at middle school and constitute a separate standard, Standard 7, at high school.

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APPENDIX 1

The "response to literature" in the Writing standard is meant to replace the more typical literary analysis paper that many students routinely produce in conjunction with literature study. This does not preclude literary analysis but instead opens up possibilities for reader response as well.

It is not intended that all student work developed to meet the English Language Arts standards should necessarily come from an English class. The challenge is to ensure that Mathematics, Science, and Applied Learning work samples are incorporated widely into the English Language Arts work samples, thus encouraging students to use work from other classes while not weakening the English curriculum.

ELEMENTARY SCHOOL

The student produces four types of writing.

A report, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- develops a controlling idea that conveys a perspective on the subject;
- creates an organizing structure appropriate to a specific purpose, audience, and context;
- includes appropriate facts and details;
- excludes extraneous and inappropriate information;
- uses a range of appropriate strategies, such as providing facts and details, describing or analyzing the subject, and narrating a relevant anecdote.

A response to literature, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- advances a judgment that is interpretive, analytic, evaluative, or reflective;
- supports a judgment through references to the text, references to other works, authors, or non-print media, or references to personal knowledge;
- demonstrates understanding of the literary work.

A narrative account (fictional or autobiographical), in which the writer:

- engages the reader by establishing a context, creating a point of view, and otherwise developing reader interest;
- establishes a situation, plot, point of view, setting, and conflict (and for autobiography, the significance of events);
- creates an organizing structure;
- includes sensory details and concrete language to develop plot and character;
- excludes extraneous details and inconsistencies;
- develops complex characters;
- uses a range of appropriate strategies, such as dialogue and tension or suspense.

A narrative procedure, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- provides a guide to action that anticipates a reader's needs, creates expectations through predictable structures, e.g., headings, and provides transitions between steps;
- makes use of appropriate writing strategies, such as creating a visual hierarchy and using white space and graphics as appropriate;
- includes relevant information;
- excludes extraneous information;
- anticipates problems, mistakes, and misunderstandings that might arise for the reader.

MIDDLE SCHOOL

The student produces five types of writing.

A report, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- develops a controlling idea that conveys a perspective on the subject;
- creates an organizing structure appropriate to purpose, audience, and context;
- includes appropriate facts and details;
- excludes extraneous and inappropriate information;
- uses a range of appropriate strategies, such as providing facts and details, describing or analyzing the subject, narrating a relevant anecdote, comparing and contrasting, naming, and explaining benefits or limitations.

A response to literature, in which the writer:

- engages the reader through establishing a context, creating a persona, and otherwise developing reader interest;
- advances a judgment that is interpretive, analytic, evaluative, or reflective;
- supports a judgment through references to the text, references to other works, authors, or non-print media, or references to personal knowledge;
- demonstrates an understanding of the literary work;
- anticipates and answers a reader's questions.

A narrative account (fictional or autobiographical), in which the writer:

- engages the reader by establishing a context, creating a point of view, and otherwise developing reader interest;
- establishes a situation, plot, point of view, setting, and conflict (and for autobiography, the significance of events and of conclusions that can be drawn from those events);
- creates an organizing structure;
- includes sensory details and concrete language to develop plot and character;
- excludes extraneous details and inconsistencies;
- develops complex characters;
- uses a range of appropriate strategies, such as dialogue, tension or suspense, naming, and specific narrative action, e.g., movement, gestures, expressions.

A narrative procedure, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- provides a guide to action for a relatively complicated procedure in order to anticipate a reader's needs, creates expectations through predictable structures, e.g., headings, and provides smooth transitions between steps;
- makes use of appropriate writing strategies, such as creating a visual hierarchy and using white space and graphics as appropriate;
- includes relevant information;
- excludes extraneous information;
- anticipates problems, mistakes, and misunderstandings that might arise for the reader.

A persuasive essay, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- develops a controlling idea that makes a clear and knowledgeable judgment;
- creates an organizing structure that is appropriate to the needs, values, and interests of a specified audience, and arranges details, reasons, examples, and anecdotes effectively and persuasively;
- includes appropriate information and arguments and excludes information and arguments that are irrelevant;
- anticipates and addresses reader concerns and counter arguments;
- supports arguments with detailed evidence, citing sources of information as appropriate.

HIGH SCHOOL

The student produces six types of writing.

A report, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- develops a controlling idea that conveys a perspective on the subject;
- creates an organizing structure appropriate to purpose, audience, and context;
- includes appropriate facts and details;
- excludes extraneous and inappropriate information;
- uses a range of appropriate strategies, such as providing facts and details, describing or analyzing the subject, narrating a relevant anecdote, comparing and contrasting, naming, explaining benefits or limitations, demonstrating claims or assertions, and providing a scenario to illustrate.

A response to literature, in which the writer:

- engages the reader through establishing a context, creating a persona, and otherwise developing reader interest;
- advances a judgment that is interpretive, analytic, evaluative, or reflective;
- supports a judgment through references to the text, references to other works, authors, or non-print media, or references to personal knowledge;
- demonstrates understanding of the literary work through suggesting an interpretation;
- anticipates and answers a reader's questions;
- recognizes possible ambiguities, nuances, and complexities.

A narrative account (fictional or autobiographical), in which the writer:

- engages the reader by establishing a context, creating a point of view, and otherwise developing reader interest;
- establishes a situation, plot, point of view, setting, and conflict (and for autobiography, the significance of events and of conclusions that can be drawn from those events);
- creates an organizing structure;
- includes sensory details and concrete language to develop plot and character;
- excludes extraneous details and inconsistencies;
- develops complex characters;
- uses a range of appropriate strategies, such as dialogue, tension or suspense, naming, pacing, and specific narrative action, e.g., movement, gestures, expressions.

A narrative procedure, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- provides a guide to action for a complicated procedure in order to anticipate a reader's needs; creates expectations through predictable structures, e.g., headings, and provides smooth transitions between steps;
- makes use of appropriate writing strategies, such as creating a visual hierarchy and using white space and graphics as appropriate;
- includes relevant information;
- excludes extraneous information;
- anticipates problems, mistakes, and misunderstandings that might arise for the reader.

A persuasive essay, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- develops a controlling idea that makes a clear and knowledgeable judgment;
- creates an organizing structure that is appropriate to the needs, values, and interests of a specified audience, and arranges details, reasons, examples, and anecdotes effectively and persuasively;
- includes appropriate information and arguments and excludes information and arguments that are irrelevant;
- anticipates and addresses reader concerns and counter arguments;
- supports arguments with detailed evidence, citing sources of information as appropriate;
- uses a range of strategies to elaborate and persuade, such as definitions, descriptions, illustrations, examples from evidence, and anecdotes.

A reflective essay, in which the writer:

- engages the reader by establishing a context, creating a persona, and otherwise developing reader interest;
- analyzes a condition or situation of significance;
- develops a commonplace, concrete occasion as the basis for the reflection, e.g., personal observation or experience;
- creates an organizing structure appropriate to purpose and audience;
- uses a variety of writing strategies, such as concrete details, comparing and contrasting, naming, describing, creating a scenario.

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3. Speaking, Listening, and Viewing

APPENDIX 1

ELEMENTARY SCHOOL

The student accesses and exchanges information; that is, the student:

- asks appropriate questions;
- responds to the questions of others;
- paraphrases and summarizes to increase understanding;
- listens responsively to others' points of view;
- uses language which is simple and appropriate for communicating;
- speaks audibly;
- makes appropriate eye contact;
- respects turn taking of other speakers;
- uses language and gestures expressively and persuasively;
- shows awareness of an audience by adjusting to its reaction.

The student responds to oral presentations; that is, the student:

- asks appropriate questions;
- paraphrases and summarizes to increase understanding;
- speaks audibly;
- uses language and gestures expressively and persuasively.

The student makes informed judgments about television, radio, and film productions; that is, the student:

- articulates reasoned judgments for selecting particular television and radio productions and rejecting others;
- recounts the story elements of television, radio, and film productions;
- identifies the intended messages of advertisements, entertainment programs, and news programs.

MIDDLE SCHOOL

The student accesses and exchanges information; that is, the student:

- asks appropriate questions;
- responds to the questions of others;
- paraphrases and summarizes to increase understanding;
- listens responsively to others' points of view;
- uses language which is simple and appropriate for communicating;
- speaks audibly;
- makes appropriate eye contact;
- respects turn taking of other speakers;
- uses language and gestures expressively and persuasively;
- shows awareness of an audience by adjusting to its reaction.

The student responds to oral presentations; that is, the student:

- asks appropriate questions;
- paraphrases and summarizes to increase understanding;
- speaks audibly;
- uses language and gestures expressively and persuasively.

The student makes informed judgments about television, radio, and film productions; that is, the student:

- articulates reasoned judgments for selecting particular television and radio productions and rejecting others;
- recounts the story elements of television, radio, and film productions;
- identifies the intended messages of advertisements, entertainment programs, and news programs;
- identifies common persuasive techniques used in advertising;
- describes ways used to portray and comment on the general culture.

HIGH SCHOOL

The student accesses and exchanges information; that is, the student:

- asks appropriate questions;
- responds to the questions of others;
- paraphrases and summarizes to increase understanding;
- listens responsively to others' points of view;
- uses language which is simple and appropriate for communicating;
- speaks audibly;
- makes appropriate eye contact;
- respects turn taking of other speakers;
- uses language and gestures expressively and persuasively;
- shows awareness of an audience by adjusting to its reaction.

The student responds to oral presentations; that is, the student:

- asks appropriate questions;
- paraphrases and summarizes to increase understanding;
- speaks audibly;
- uses language and gestures expressively and persuasively.

The student makes informed judgments about television, radio, and film productions; that is, the student:

- articulates reasoned judgments for selecting particular television and radio programs and rejecting others;
- recounts the story elements of television, radio, and film productions;
- identifies the intended messages of advertisements, entertainment programs, and news programs;
- identifies the common persuasive techniques used in advertising;
- describes ways used to portray and comment on the general culture;
- demonstrates an understanding of media stereotyping and other socially significant portrayals;
- understands the effects of media production techniques on viewers' perceptions, including the use of music, camera angles, fade-outs.

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4. Conventions, Grammar, and Usage of the English Language

APPENDIX 1

ELEMENTARY SCHOOL

The student regularly uses, with some teacher assistance, appropriate conventions of the English language, including:

- spelling;
- sentence construction;
- paragraph structure;
- punctuation;
- grammar;
- usage.

The student analyzes and revises written work, as appropriate, relative to audiences and purposes by:

- adding or deleting details;
- adding or deleting explanations;
- clarifying difficult passages;
- rearranging words, sentences, and paragraphs to improve or clarify meaning;
- sharpening the focus;
- reconsidering the organizational structure.

MIDDLE SCHOOL

The student independently uses appropriate conventions of the English language, including:

- spelling;
- sentence construction;
- paragraph structure;
- punctuation;
- grammar;
- usage.

The student analyzes and revises written work, as appropriate, relative to audiences and purposes by:

- adding or deleting details;
- adding or deleting explanations;
- clarifying difficult passages;
- rearranging words, sentences, and paragraphs to improve or clarify meaning;
- sharpening the focus;
- reconsidering the organizational structure.

HIGH SCHOOL

The student independently and habitually uses the appropriate conventions of the English language, including:

- spelling;
- sentence construction;
- paragraph structure;
- punctuation;
- grammar;
- usage.

The student analyzes and revises written work, as appropriate, relative to audiences and purposes by:

- adding or deleting details;
- adding or deleting explanations;
- clarifying difficult passages;
- rearranging words, sentences, and paragraphs to improve or clarify meaning;
- sharpening the focus;
- reconsidering the organizational structure.

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5. Literature

APPENDIX 1

ELEMENTARY SCHOOL

The student responds to fiction, non-fiction, poetry, and drama using interpretive, critical, and evaluative processes; that is, the student does one or more of the following in oral and written presentations:

- examines the reasons for a character's actions, taking into account the situation and basic motivation of the character;
- identifies recurring themes across works;
- identifies stereotypical characters as opposed to fully developed characters;
- critiques the degree to which a plot is contrived or realistic;
- makes inferences and draws conclusions about context, events, characters, and setting;
- analyzes the impact of authors' decisions regarding word choice and content;
- considers the function of point of view or persona;
- considers the differences among genres;
- evaluates literary merit.

The student writes works in specific genres that incorporate appropriate literary features.

MIDDLE SCHOOL

The student responds to fiction, non-fiction, poetry, and drama using interpretive, critical, and evaluative processes; that is, the student does one or more of the following in oral and written presentations:

- analyzes the reasons for a character's actions, taking into account the situation and basic motivation of the character;
- identifies recurring themes across works;
- identifies stereotypical characters as opposed to fully developed characters;
- makes inferences and draws conclusions about context, events, characters, setting, and theme;
- identifies the effect of literary devices such as figurative language, allusion, diction, dialogue, and description;
- interprets the impact of authors' decisions regarding word choice, content, and literary elements;
- identifies the characteristics of literary forms and genres;
- evaluates literary merit;
- identifies the effect of point of view.

The student demonstrates proficiency in at least one literary genre.

HIGH SCHOOL

The student responds to fiction, non-fiction, poetry, and drama using interpretive, critical, and evaluative processes; that is, the student does one or more of the following in oral and written presentations:

- makes inferences and draws conclusions about content, events, characters, setting, theme, and style;
- interprets the effect of literary devices, such as figurative language, allusion, diction, dialogue, description, symbolism;
- evaluates the impact of authors' decisions regarding word choice, style, content, and literary elements;
- analyzes the characteristics of literary forms and genres;
- evaluates literary merit;
- explains the effect of point of view;
- makes thematic connections among literary texts, public discourse, and media;
- interprets ambiguities, subtleties, contradictions, ironies, and nuances;
- demonstrates how literary works reflect the period which shaped them.

The student demonstrates proficiency in at least one literary genre.

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APPENDIX 2

The elementary school standards are set at a level of performance approximately equivalent to the end of fourth grade. The middle school standards are set at a level of performance approximately equivalent to the end of eighth grade. The high school standards are set at a level of performance approximately equivalent to the end of tenth grade. It is expected that some students might achieve these levels earlier and others later than these grades.

ELEMENTARY SCHOOL

The student:

- adds, subtracts, multiplies, and divides whole numbers, with and without calculators; that is, the student:
  - adds, i.e., joins things together, increases;
  - subtracts, i.e., takes away, compares, finds the difference;
  - multiplies, i.e., uses repeated addition, counts by multiples, combines things that come in groups, makes arrays, uses area models, computes simple scales, uses simple rates;
  - divides, i.e., puts things into groups, shares equally; calculates simple rates;
  - analyzes problem situations and contexts in order to figure out when to add, subtract, multiply, or divide;
  - solves arithmetic problems by relating addition, subtraction, multiplication and division to one another;
  - computes answers mentally, e.g., 27 + 45, 30 x 4;
  - uses simple concepts of negative numbers, e.g., on a number line, in counting, in temperature, "owing";
- demonstrates understanding of the base ten place value system and uses this knowledge to solve arithmetic tasks; that is, the student:
  - counts 1, 10, 100 or 1,000 more than or less than, e.g., one less than 100,000, 10 more than 380, 1,000 more than 23,000, 100 less than 9,000, during arithmetic activities and problem solving;
- uses knowledge about ones, tens, hundreds and thousands to figure out answers to multiplication and division tasks, e.g. 36 x 10, 18 x 100, 7 x 1,000, 4,000 ÷ 4, during arithmetic activities and problem solving;
- estimates, approximates, rounds off, or uses exact numbers, as appropriate, in calculations;
- describes and compares quantities by using simple fractions; that is, the student:
  - finds simple parts of wholes;
  - recognizes simple fractions as instructions to divide, e.g., $\frac{1}{4}$ of something is the same as dividing something by 4;
  - recognizes the place of fractions on number lines, e.g., in measurement;
  - uses drawings, diagrams, or models to show what the numerator and denominator mean, including when adding like fractions, e.g., $\frac{1}{8} + \frac{3}{8}$;
  - uses beginning proportional reasoning and simple ratios, e.g., "about half of the people";
- describes and compares quantities by using decimals; that is, the student:
  - adds, subtracts, multiplies, and divides money amounts;
  - recognizes that decimals are another way of writing fractions, e.g., $0.3 = \frac{3}{10}$;
  - recognizes relationships among simple fractions, decimals, and percents, e.g., that $\frac{1}{2}$ is the same as 0.5, and $\frac{1}{2}$ is the same as 50%;
- describes and compares quantities by using whole numbers up to 1,000,000; that is, the student:
  - connects ideas of quantities to the real world, e.g., how many people fit in a baseball stadium; how far away is a kilometer in your city;
  - finds, identifies, and sorts numbers by their properties, e.g., odd, even; and for two-digit numbers, prime, square, and composite.

MIDDLE SCHOOL

The student:

- consistently and accurately adds, subtracts, multiplies, and divides rational numbers; raises rational numbers to whole number powers;
- understands the inverse relationships between addition and subtraction, multiplication and division, and exponentiation and root-extraction; and uses the inverse operation to determine unknown quantities in equations;
- consistently and accurately computes with, applies, and converts the different kinds and forms of rational numbers, i.e., integers (both whole numbers and negative integers) and other positive and negative rationals, written as decimals, as percents, or as proper, improper, or mixed fractions; irrational numbers, i.e., those that cannot be written as a ratio of two integers, are not required but are suitable for introduction, especially since the student should be familiar with the irrational number π;
- is familiar with characteristics of operations and numbers, e.g., divisibility, prime factorization, and with properties of rational numbers, e.g., commutativity and associativity, short of formal statements;
- interprets percent as part of 100 and as a means of comparing quantities of different sizes or changing sizes;
- reasons proportionally to solve problems involving equivalent fractions or equal ratios;
- orders numbers with the > and < relationships and by location on a number line and has a sense of the magnitudes and relative magnitudes of numbers; note that scientific notation is not required.

HIGH SCHOOL

The student:

- uses the properties of addition, subtraction, multiplication, division, exponentiation, and root-extraction in forming and working with algebraic expressions;
- understands and uses unary operations, such as opposite, reciprocal, absolute value, raising to a fixed power, taking a root, and taking a logarithm;
- has facility with the mechanics of binary and unary operations as well as understanding of their typical meaning and uses in applications;
- understands and uses number systems, that is, natural, integer, rational, and real;
- represents numbers in decimal or fraction form and in scientific notation; and graphs numbers on the number line and in the coordinate plane;
- compares numbers of different magnitude using order relations, differences, ratios, proportions, percents, proportional change, and location on the number line;
- uses dimensionless numbers, such as proportions, percents, and multiplicative factors, and numbers with specific units of measure, including length, time, and rate units;
- recognizes and represents basic number patterns.

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2. Geometry and Measurement Concepts

APPENDIX 2

ELEMENTARY SCHOOL

The student:

- works with many types of figures and their properties, including angles (right, obtuse, acute), triangles, squares, rectangles, rhombi, parallelograms, quadrilaterals, polygons, prisms, pyramids, cubes, circles, and spheres;
- identifies, classifies, and names geometric figures by specific shape properties, e.g., symmetry;
- solves problems by showing relationships between and among figures, e.g., using congruence and similarity, and using transformations including flips, slides, and rotations;
- extends and creates geometric patterns using concrete and pictorial models;
- uses basic ways of measuring the size of figures, including length, width, perimeter, and area;
- uses models to reason about the relationship between the perimeter and area of rectangles in simple situations;
- selects and uses appropriate units for measuring quantities such as weight, length, area, volume, and time;
- carries out simple unit conversions, such as between cm and m, and between hours and minutes;
- measures and creates a scale in maps or scale drawings using the idea of constant ratio.

MIDDLE SCHOOL

The student:

- is familiar with assorted two- and three-dimensional objects, including squares, triangles, other polygons, circles, cubes, rectangular prisms, i.e., "boxes," pyramids, spheres, and cylinders;
- identifies similar and congruent shapes and uses transformations in the coordinate plane, i.e., translations, rotations, and reflections;
- understands length, area, and volume (as well as the differences between these measurements) and the corresponding uses of units, square units, and cubic units of measure;
- recognizes similarity and rotational and bilateral symmetry in two- and three-dimensional figures;
- analyzes and generalizes geometric patterns, such as tessellations and sequences of shapes;
- measures angles, weights, capacities, times, and temperatures using appropriate units;
- chooses appropriate units of measure and converts with ease between like units, e.g., inches and miles, within a customary or metric system; note that conversions between customary and metric are not required;
- reasons proportionally in situations with similar figures;
- reasons proportionally with measurements to interpret maps and to make smaller and larger scale drawings;
- models situations geometrically to formulate and solve problems.

HIGH SCHOOL

The student:

- works with many types of figures and their properties, including polygons and circles, cubes and pyramids, and cylinders, cones, and spheres;
- uses relationships between figures involving congruence and similarity; and characterizes such properties in terms of transformations;
- knows, uses, and derives formulas for area, surface area, and volume of many types of figures;
- uses the Pythagorean Theorem in many types of situations and knows how to prove the theorem;
- works with similar triangles and extends the ideas to include definitions and simple uses of the three basic trigonometric functions;
- analyzes figures in terms of the kinds of symmetries they have;
- studies geometric patterns, including sequences of growing shapes and characterizes the pattern in terms of properties of the n^{th} stage;
- works with geometric measures of length, area, surface area, volume, and angle; and non-geometric measures of weight, monetary value, and time;
- uses quotient measures, such as speed and density, relating them to slope and "per unit" amounts; and uses product measures such as person-days;
- understands the structure of standard measurement systems, both SI and customary, including derived units, unit conversions, and dimensional analysis;
- carries out proportional reasoning; in cases involving expansions and contractions, that is, in situations where sizes in the expanded or contracted figure are proportional to the corresponding sizes in the original figure; and in cases involving figures composed of many identical parts, that is, in situations where the size of the whole is proportional to the number of parts;
- solves problems involving scale and change of scale in maps and diagrams;
- represents geometric curves and graphs of functions in standard coordinate systems;
- analyzes geometric figures and proves things about them using deductive methods;
- models situations geometrically to formulate and solve problems.

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3. Function and Algebra Concepts

The Grade Levels Compared: *Mathematics*

APPENDIX 2

ELEMENTARY SCHOOL

The student:

- uses linear patterns to solve problems; that is, the student:
  - shows how one quantity determines another in a linear pattern, i.e. describes, extends, and recognizes the linear pattern by its rule, such as, the total number of legs on a given number of horses can be calculated by counting by fours;
  - shows how one quantity determines another quantity in a functional relationship based on a linear pattern, e.g., for the "number of people and total number of eyes," figure out how many eyes 100 people have all together;
- builds iterations of simple non-linear patterns, including multiplicative and squaring patterns, with concrete materials and recognizes that these patterns are not linear;
- shows that an equality relationship between two quantities remains the same as long as the same change is made to both quantities;
- uses letters, boxes, or other symbols to stand for any number, measured quantity, or object in simple situations with concrete materials, i.e., demonstrates understanding and use of a beginning concept of a variable.

MIDDLE SCHOOL

The student:

- discovers, describes, and generalizes patterns, including linear, exponential, and simple quadratic relationships, i.e., those of the form $f(n)=n^2$ or $f(n)=cn^2$, for constant c, including $A=\pi r^2$, and represents them with variables and expressions;
- represents relationships with tables, graphs in the coordinate plane, and verbal or symbolic rules;
- analyzes tables, graphs, and rules to determine functional relationships;
- finds solutions for unknown quantities in linear equations and in simple equations and inequalities.

HIGH SCHOOL

The student:

- models given situations with linear, exponential, or quadratic functions and interprets given functions in terms of situations;
- discovers, describes, generalizes, and uses basic types of functions; that is, linear, exponential, periodic, power, rational, squares and square roots, and cubes and cube roots;
- works with properties and mechanics of functions; that is, evaluation, inverses, slope, local maxima and minima;
- works with many kinds of rate relationships in constant rate situations;
- uses linear (arithmetic) sequences and exponential (geometric) sequences;
- defines and uses variables, parameters, constants, and unknowns in work with both functions and equations;
- solves equations both symbolically and graphically, especially linear, quadratic, and exponential equations; and knows the quadratic formula and its derivation;
- represents functional relationships in formulas, tables, and graphs, and translates among these;
- understands the basic algebraic structure of number systems;
- is familiar with 2 by 2 matrices, their arithmetic, and some of their uses, such as solving systems of equations and representing symmetries and transformations;
- uses equations to represent curves such as lines, circles, ellipses, parabolas, and hyperbolas;
- uses functions to represent patterns.

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4. Statistics and Probability Concepts

ELEMENTARY SCHOOL

The student:

- collects and organizes data to answer a question or test a hypothesis by comparing sets of data;
- displays data in graphs, tables, and charts;
- makes statements and draws simple conclusions based on data; that is, the student:
  - reads for information data in tables, charts, and graphs;
  - compares data in order to make true statements, e.g., "seven plants grew at least 5 cm";
  - identifies and uses the mode necessary for making true statements, e.g., "most people chose red";
  - makes true statements based on a simple concept of "average" or mean, for a small sample size and where the situation is made evident with concrete materials or clear representations;
  - interprets data to determine the reasonableness of statements about the data, e.g., "twice as often," "three times faster";
  - uses data, including statements about the data, to make a simple concluding statement about a situation, e.g., "This kind of plant grows better near sunlight because the seven plants that were near the window grew at least 5 cm";
- gathers data about an entire group or by sampling group members to understand the concept of "sample", e.g., that a large sample leads to more reliable information;
- predicts and finds out why some outcomes are more likely, less likely, or equally likely;
- finds all possible combinations and arrangements within certain constraints involving a limited number of variables.

MIDDLE SCHOOL

The student:

- collects and organizes data and displays data with appropriate tables, charts, and graphs;
- analyzes data with respect to characteristics of frequency and distribution, including mode and range;
- analyzes appropriately central tendencies of data with mean and median;
- makes conclusions and recommendations based on data analysis;
- critiques the conclusions and recommendations of others' statistics;
- considers effects on reliability of sampling procedures and of missing or incorrect information;
- formulates hypotheses to answer a question and uses data to test hypotheses;
- recognizes equally likely outcomes, constructs sample spaces, and determines probabilities of events;
- makes predictions based on experimental or theoretical probabilities;
- predicts the result of a series of trials once the probability for one trial is known.

HIGH SCHOOL

The student:

- collects, organizes, displays, and analyzes single-variable data using frequency distributions, histograms, and summary statistics;
- collects, organizes, displays, and analyzes two-variable data using scatter plots, estimated regression lines, and computer-generated regression lines and correlation coefficients;
- understands the role of assumptions and uncertainty in making inferences;
- critiques conclusions and the use of statistics in public documents;
- uses sampling techniques to draw inferences about large populations;
- explores questions of experimental design, use of control groups, and reliability;
- formulates hypotheses to answer a question and uses data to test hypotheses;
- uses theoretical probability models to arrive at probabilities for chance events;
- uses experimental measures of likelihood based on gathering of data to arrive at relative frequencies for chance events;
- uses simulations to estimate probabilities;
- sets up and works with appropriate sample spaces and applies the addition and multiplication principles appropriately;
- works with the normal distribution in some of its basic uses.

APPENDIX 2

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5. Problem Solving and Mathematical Reasoning

APPENDIX 2

ELEMENTARY SCHOOL

The student solves problems that make significant demands in one or more of these aspects of the solution process: problem formulation, problem implementation, and problem conclusion.

Problem formulation
The student participates in the formulation of problems; that is, given the basic statement of a problem situation, the student:

- makes decisions about the approach, materials, and strategies to use;
- uses previously learned strategies, skills, knowledge, and concepts to make decisions;
- uses strategies, such as using manipulatives or drawing sketches, to model problems;
- does not merely fill in a given chart, use a pre-specified manipulative or go through a predetermined set of steps.

Problem implementation
The student makes the basic choices involved in planning and carrying out a solution; that is, the student:

- makes up and uses a variety of strategies and approaches to solving problems and learns approaches that other people use;
- makes connections among concepts in order to solve problems;
- solves problems in ways that make sense and explains why these ways make sense, e.g., defends the reasoning, explains the solution.

Problem conclusion
The student moves beyond a particular problem by making connections, extensions, and/or generalizations; for example, the student:

- explains a pattern that can be used in similar situations;
- explains how the problem is similar to other problems he or she has solved;
- explains how the mathematics used in the problem is like other concepts in mathematics;
- explains how the problem solution can be applied to other school subjects and in real world situations;
- makes the solution into a general rule that applies to other circumstances.

MIDDLE SCHOOL

The student solves problems that make significant demands in one or more of these aspects of the solution process: problem formulation, problem implementation, and problem conclusion.

Problem formulation
The student:

- formulates and solves a variety of meaningful problems;
- extracts pertinent information from situations and figures out what additional information is needed;
- formulates conjectures and argues, short of formal proof, why they must be or seem true.

Problem implementation
The student:

- uses and invents a variety of approaches and understands and evaluates those of others;
- invokes problem solving strategies, such as illustrating with sense making sketches to clarify situations or organizing information in a table;
- determines, where helpful, how to break a problem into simpler parts;
- solves for unknown or undecided quantities using algebra, graphing, sound reasoning, and other strategies;
- integrates concepts and techniques from different areas of mathematics;
- works effectively in teams when the nature of the task or the allotted time makes this an appropriate strategy;
- makes sensible, reasonable estimates;
- makes justified, logical statements.

Problem conclusion
The student:

- verifies and interprets results with respect to the original problem situation;
- generalizes solutions and strategies to new problem situations.

HIGH SCHOOL

The student solves problems that make significant demands in one or more of these aspects of the solution process: problem formulation, problem implementation, and problem conclusion.

Problem formulation
The student participates in the formulation of problems; in particular, given the basic statement of a problem situation, the student:

- fills out the formulation of a definite problem that is to be solved;
- extracts pertinent information from the situation as a basis for working on the problem;
- asks and answers a series of appropriate questions in pursuit of a solution and does so with minimal "scaffolding" in the form of detailed guiding questions.

Problem implementation
The student makes the basic choices involved in planning and carrying out a solution; in particular, the student:

- chooses and employs effective problem solving strategies in dealing with non-routine and multi-step problems;
- selects appropriate mathematical concepts and techniques from different areas of mathematics and applies them to the solution of the problem;
- applies mathematical concepts to new situations within mathematics and uses mathematics to model real world situations involving basic applications of mathematics in the physical sciences, the social sciences, and business.

Problem conclusion
The student provides closure to the solution process through summary statements and general conclusions; in particular, the student:

- concludes a solution process with a useful summary of results;
- evaluates the degree to which the results obtained represent a good response to the initial problem;
- formulates generalizations of the results obtained;
- carries out extensions of the given problem to related problems.

Mathematical Reasoning
The student not only makes observations and states results but also justifies or proves why the results hold in general; in particular, the student:

- employs forms of mathematical reasoning and proof appropriate to the solution of the problem at hand, including deductive and inductive reasoning, making and testing conjectures, and using counterexamples and indirect proof;
- differentiates clearly between giving examples that support a conjecture and giving a proof of the conjecture.

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6. Mathematical Skills and Tools

APPENDIX 2

ELEMENTARY SCHOOL

The student:

- adds, subtracts, multiplies, and divides whole numbers correctly; that is, the student:
  - knows single digit addition, subtraction, multiplication, and division facts;
  - adds and subtracts numbers with several digits;
  - multiplies and divides numbers with one or two digits;
  - multiplies and divides three digit numbers by one digit numbers;
- estimates numerically and spatially;
- measures length, area, perimeter, circumference, diameter, height, weight, and volume accurately in both the customary and metric systems;
- computes time and money; that is the student:
  - computes lengths of time in hours and minutes;
  - calculates money amounts in dollars and cents;
- refers to geometric shapes and terms correctly with concrete objects, including triangle, square, rectangle, rhombus, parallelogram, quadrilateral, polygon, polyhedron, angle (right, acute, obtuse), side, edge, face, cube, vertex, point, line, perimeter, area, volume, circle, diameter, circumference, sphere, prism, and pyramid;
- uses +, -, x, ÷, /, —, $, ¢, %, and . (decimal point) correctly in number sentences and expressions;
- reads, creates, and represents data on charts, tables, diagrams, bar graphs, simple circle graphs, and coordinate graphs;
- uses recall, mental computations, pencil and paper, measuring devices, mathematics texts, manipulatives, calculators, computers, and advice from peers, as appropriate, to achieve solutions; that is, the student:
  - uses measuring devices, graded appropriately for given situations, such as rulers (customary to the $\frac{1}{16}$ inch; metric to the millimeter), protractors, compasses, graph paper (customary to the inch or half-inch; metric to the centimeter), measuring cups (customary to the ounce; metric to the milliliter), scales (customary to the pound or ounce; metric to the kilogram or gram);
  - interprets long decimals that result from dividing on calculators, by rounding to the nearest appropriate place (whole number, tenth or hundredth).

MIDDLE SCHOOL

The student:

- computes accurately with arithmetic operations on rational numbers;
- knows and uses the correct order of operations for arithmetic computations;
- estimates numerically and spatially;
- measures length, area, volume, weight, time, and temperature accurately;
- refers to geometric shapes and terms correctly;
- uses equations, formulas, and simple algebraic notation appropriately;
- organizes data on charts and graphs, including scatter plots, bar, line, and circle graphs, and Venn diagrams;
- uses recall, mental computations, pencil and paper, measuring devices, mathematics texts, manipulatives, calculators, computers, and advice from peers, as appropriate, to achieve solutions.

HIGH SCHOOL

The student:

- computes accurately using arithmetic and algebraic operations on whole and rational numbers, using both pencil and paper and technology;
- makes reasonable estimates in appropriate units of quantities met in applications;
- evaluates and analyzes functions of many kinds, using both pencil and paper and technology;
- uses basic geometric terminology accurately and deduces information about basic geometric figures in solving problems;
- makes and uses rough sketches, schematic diagrams, or precise scale diagrams to enhance a solution;
- plots points on the number line, in the plane, and in space;
- creates and interprets graphs of many kinds, such as circle graphs, function graphs, scatter plots, regression lines, and histograms;
- sets up and solves equations symbolically (when possible) and graphically;
- uses technology to create graphs or spreadsheets that contribute to the understanding of a problem;
- knows how to write a simple computer program to carry out computations to be repeated many times;
- knows standard methods to solve basic problems and uses these methods in approaching more complex problems;
- carries out numerical calculations and symbol manipulations effectively, using mental computations, pencil and paper, or technological aids, as appropriate.

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7. Mathematical Communication

The Grade Levels Compared: *Mathematics*

APPENDIX 2

ELEMENTARY SCHOOL

The student:

- uses appropriate mathematical terms, vocabulary and language, based on prior conceptual work;
- shows ideas in a variety of ways, including words, numbers, symbols, pictures, charts, graphs, tables, diagrams, and models;
- explains clearly and logically solutions to problems, and supports solutions with evidence, in both oral and written form;
- considers purpose and audience when communicating;
- comprehends mathematics from reading assignments and from other sources.

MIDDLE SCHOOL

The student:

- uses mathematical language and representations with appropriate accuracy, including numerical tables and equations, simple algebraic equations and formulas, charts, graphs, and diagrams;
- organizes work, explains facets of a solution orally and in writing, labels drawings, and uses other techniques to make meaning clear to the audience;
- uses mathematical language to make complex situations easier to understand;
- exhibits developing reasoning abilities by justifying statements and defending work;
- shows understanding of concepts by explaining ideas not only to teachers and assessors but to fellow students or younger children;
- comprehends mathematics from reading assignments and from other sources.

HIGH SCHOOL

The student:

- is familiar with basic mathematical vocabulary and terminology, standard notation and use of symbols, common conventions for graphing, and general features of effective mathematical communication styles;
- uses mathematical representations with appropriate accuracy, including numerical tables, formulas, functions, algebraic equations, charts, graphs, and diagrams;
- presents mathematical procedures and results clearly, systematically, succinctly, and correctly;
- communicates logical arguments clearly, showing why a result makes sense and why the reasoning is valid;
- describes and discusses mathematical ideas effectively both orally and in writing;
- explains mathematical concepts or ideas clearly to peers or others who may be having difficulty with them;
- reads mathematical texts and other writing about mathematics with understanding.

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APPENDIX 2

ELEMENTARY SCHOOL

The student conducts at least one large scale project each year drawn from the following kinds and, over the course of elementary school, projects drawn from at least three of the kinds.

A single project may draw on more than one kind.

Data study, in which the student:

- develops a question and a hypothesis in a situation where data could help make a decision or recommendation;
- decides on a group or groups to be sampled and makes predictions of the results, with specific percents, fractions, or numbers;
- collects, represents, and displays data in order to help make the decision or recommendation; compares the results with the predictions;
- writes a report that includes recommendations supported by diagrams, charts, and graphs; acknowledges assistance received from parents, peers, and teachers.

Science study, in which the student:

- decides on a specific science question to study and identifies the mathematics that will be used, e.g., measurement;
- develops a prediction (a hypothesis) and develops procedures to test the hypothesis;
- collects and records data; represents and displays data; compares results to predictions;
- writes a report that compares the results with the hypothesis; supports the results with diagrams, charts, and graphs; acknowledges assistance received from parents, peers, and teachers.

Design of a physical structure, in which the student:

- decides on a structure to design, the size and budget constraints, and the scale of design;
- makes a first draft of the design, and revises and improves the design in response to input from peers and teachers;
- makes a final draft and report of the design, drawn and written so that another person could make the structure; acknowledges assistance received from parents, peers, and teachers.

Management and planning, in which the student:

- decides on what to manage or plan and what goal will be used to see if the plan worked;
- identifies unexpected events that could disrupt the plan and further plans for such contingencies;
- identifies resources needed, e.g., materials, money, time, space, and other people;
- writes down a detailed plan; revises and improves the plan in response to feedback from peers and teachers;
- carries out the plan (optional);
- writes up a report on the plan, that includes resources, budget, and schedule; acknowledges assistance received from parents, peers, and teachers.

Pure mathematics investigation, in which the student:

- decides on the area of mathematics to investigate, e.g., numbers, shapes, patterns;
- describes a question or concept that he or she will seek to better understand;
- decides on representations that will be used, e.g., numbers, symbols, diagrams, shapes, or physical models;
- carries out the investigation;
- writes up a report, including generalizations if there were any; acknowledges assistance received from parents, peers, and teachers.

Other kinds of projects involving putting mathematics to work, chosen by the student or teacher, in which the student:

- identifies, with the teacher, and writes down a clear purpose for the project, what will be accomplished, and how the project involves putting mathematics to work;
- develops a question and a plan; writes a detailed description of how the project was carried out, including mathematical analysis of the results; and a report that includes acknowledgment of assistance received from parents, peers, and teachers.

MIDDLE SCHOOL

The student conducts at least one large scale investigation or project each year drawn from the following kinds and, over the course of middle school, investigations or projects drawn from at least three of the kinds.

A single investigation or project may draw on more than one kind.

Data study based on civic, economic, or social issues, in which the student:

- selects an issue to investigate;
- makes a hypothesis on an expected finding;
- gathers data;
- analyzes the data using concepts from Standard 4, e.g., considering mean and median, and the frequency and distribution of the data;
- shows how the study's results compare with the hypothesis;
- uses pertinent statistics to summarize;
- prepares a presentation or report that includes the question investigated, a detailed description of how the project was carried out, and an explanation of the findings.

Mathematical model of physical phenomena, often used in science studies, in which the student:

- carries out a study of a physical system using a mathematical representation of the structure;
- uses understanding from Standard 3, particularly with respect to the determination of the function governing behavior in the model;
- generalizes about the structure with a rule, i.e., a function, that clearly applies to the phenomenon and goes beyond statistical analysis of a pattern of numbers generated by the situation;
- prepares a presentation or report that includes the question investigated, a detailed description of how the project was carried out, and an explanation of the findings.

Design of a physical structure, in which the student:

- generates a plan to build something of value, not necessarily monetary value;
- uses mathematics from Standard 2 to make the design realistic or appropriate, e.g., areas and volumes in general and of specific geometric shapes;
- summarizes the important features of the structure;
- prepares a presentation or report that includes the question investigated, a detailed description of how the project was carried out, and an explanation of the findings.

Management and planning, in which the student:

- determines the needs, e.g., cost, supply, scheduling, of the event to be managed or planned;
- notes any constraints that will affect the plan;
- determines a plan;
- uses concepts from any of Standards 1 to 4, depending on the nature of the project;
- considers the possibility of a more efficient solution;
- prepares a presentation or report that includes the question investigated, a detailed description of how the project was carried out, and an explanation of the plan.

Pure mathematics investigation, in which the student:

- extends or "plays with," as with mathematical puzzles, some mathematical feature, e.g., properties and patterns in numbers;
- uses concepts from any of Standards 1 to 4, e.g., an investigation of Pascal's triangle would have roots in Standard 1 but could tie in concepts from geometry, algebra, and probability; investigations of derivations of geometric formulas would be rooted in Standard 2 but could require algebra;
- determines and expresses generalizations from patterns;
- makes conjectures on apparent properties and argues, short of formal proof, why they seem true;
- prepares a presentation or report that includes the question investigated, a detailed description of how the project was carried out, and an explanation of the findings.

Other kinds of projects putting mathematics to work chosen by student or teacher.

HIGH SCHOOL

The student conducts at least one large scale investigation or project each year drawn from the following kinds and, over the course of high school, investigations or projects drawn from at least three of the kinds.

A single investigation or project may draw on more than one kind.

Data study, in which the student:

- carries out a study of data relevant to current civic, economic, scientific, health, or social issues;
- uses methods of statistical inference to generalize from the data;
- prepares a report that explains the purpose of the project, the organizational plan, and conclusions, and uses an appropriate balance of different ways of presenting information.

Mathematical model of a physical system or phenomenon, in which the student:

- carries out a study of a physical system or phenomenon by constructing a mathematical model based on functions to make generalizations about the structure of the system;
- uses structural analysis (a direct analysis of the structure of the system) rather than numerical or statistical analysis (an analysis of data about the system);
- prepares a report that explains the purpose of the project, the organizational plan, and conclusions, and uses an appropriate balance of different ways of presenting information.

Design of a physical structure, in which the student:

- creates a design for a physical structure;
- uses general mathematical ideas and techniques in discussing specifications for building the structure;
- prepares a report that explains the purpose of the project, the organizational plan, and conclusions, and uses an appropriate balance of different ways of presenting information.

Management and planning analysis, in which the student:

- carries out a study of a business or public policy situation involving issues such as optimization, cost-benefit projections, and risks;
- uses decision rules and strategies both to analyze options and balance trade-offs; and brings in mathematical ideas that serve to generalize the analysis across different conditions;
- prepares a report that explains the purpose of the project, the organizational plan, and conclusions, and uses an appropriate balance of different ways of presenting information.

Pure mathematics investigation, in which the student:

- carries out a mathematical investigation of a phenomenon or concept in pure mathematics;
- uses methods of mathematical reasoning and justification to make generalizations about the phenomenon;
- prepares a report that explains the purpose of the project, the organizational plan, and conclusions, and uses an appropriate balance of different ways of presenting information.

History of a mathematical idea, in which the student:

- carries out a historical study tracing the development of a mathematical concept and the people who contributed to it;
- prepares a report that explains the purpose of the project, the organizational plan, and conclusions, and uses an appropriate balance of different ways of presenting information.

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APPENDIX 3

The elementary school standards are set at a level of performance approximately equivalent to the end of fourth grade. The middle school standards are set at a level of performance approximately equivalent to the end of eighth grade. The high school standards are set at a level of performance approximately equivalent to the end of tenth grade. It is expected that some students might achieve these levels earlier and others later than these grades.

The Science standards are founded upon both the American Association for the Advancement of Science's Project 2061 *Benchmarks for Scientific Literacy* and the National Research Council's *National Science Education Standards draft*. The Science standards will also take into account the work of the National Science Teachers Association as they revise their *Scope, Sequence, and Coordination Content Core* and develop assessment tasks.

These documents, each of which runs to several hundred pages, contain detail that amplifies the meaning of the terms used here.

ELEMENTARY SCHOOL

The student understands:

- the observable properties of objects and materials;
- motions of objects, in particular, push and pull, sound;
- heat, light, electricity, and magnetism.

MIDDLE SCHOOL

The student understands:

- characteristic properties of matter, in particular, density; conservation of matter;
- motions and forces, and the relationships among them, for example, effects of unbalanced forces;
- transfer and transformations of energy, including forms and conversion.

HIGH SCHOOL

The student understands:

- structure and properties of matter, in particular, composition of atoms, bonding, elements and compounds;
- chemical reactions, including concentration, pressure, temperature, catalysts;
- forces and motions, including net force, gravitational, electrical, magnetic;
- conservation of energy, in particular, transfer, heat;
- interactions of energy and matter, especially waves and wavelengths.

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APPENDIX 3

ELEMENTARY SCHOOL

The student understands:

- characteristics of organisms; that is, needs, environments that meet them; structures, especially senses; variation and behaviors, inherited and learned;
- life cycles, including birth, development, reproduction;
- organisms and environments, in particular, food chains, populations, effects on the environment;
- change over time, including fossil evidence.

MIDDLE SCHOOL

The student understands:

- structure and function of cells, tissues, and organs;
- reproduction and heredity, including genes, traits, and learning;
- regulation and behavior, especially the roles of senses and hormones;
- population and ecosystems, including food webs, resources, and energy;
- evolution, in particular, species, diversity and adaptation, variation, extinction.

HIGH SCHOOL

The student understands:

- cells, including structure and function, uses of energy and food;
- molecular basis of heredity, including DNA, chromosomes, mutations;
- behavior of organisms, especially hormones, nervous system, evolution;
- interdependence of organisms, especially flow of energy, cooperation and competition, environmental constraints;
- biological evolution, in particular, natural selection; and adaptation, including species, variation, extinction.

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3. Earth and Space Sciences Concepts

APPENDIX 3

ELEMENTARY SCHOOL

The student understands:

- properties and uses of Earth materials, including rocks, soils, water, and gases;
- patterns, cycles, seasons, time, weather, and Earth motion;
- change over time, for example, erosion.

MIDDLE SCHOOL

The student understands:

- Earth's systems, including crustal plates and land forms; rock cycle, water cycle; weather and oceans;
- Earth's history, especially change over time, erosion, movement of plates, fossil evidence;
- Earth in the Solar System, including day, year; sun, planet; gravity, energy;
- natural resource management.

HIGH SCHOOL

The student understands:

- Earth's systems, including the Sun, radioactive decay, gravitational energy; weather and climate;
- origin and evolution of the Earth system, in particular, estimating geologic time, age of life forms;
- forces that shape the Earth; that is, processes and observable results;
- natural resource management.

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4. Scientific Connections and Applications

ELEMENTARY SCHOOL

The student understands:

- big ideas and unifying concepts, for example, order, models, form, change, cause and effect;
- the designed world, in particular, agriculture and technology;
- health, especially nutrition, germs, toxic substances, safety;
- science as a human endeavor.

MIDDLE SCHOOL

The student understands:

- big ideas and unifying concepts; for example, order and organization, models, systems, evolution and equilibrium, form and function, cause and effect, constancy and change;
- technology, including tradeoffs, constraints, feedback, risk;
- the designed world, including agriculture and industry;
- health, especially nutrition, exercise, and disease; toxic substances; safety; relationships with the environment;
- historical and contemporary impact of science.

HIGH SCHOOL

The student understands:

- big ideas and unifying concepts; for example, order and organization, models, systems, evolution and equilibrium, form and function, cause and effect, constancy and change;
- technology, including cost/benefit, constraints, feedback, risk;
- the designed world, including agriculture and industry;
- health, especially nutrition, exercise, and disease; toxic substances; safety; relationship to environment;
- historical and contemporary impact of science.

APPENDIX 3

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APPENDIX 3

ELEMENTARY SCHOOL

The student uses scientific reasoning strategies, scientific knowledge, and common sense to formulate questions about, understand, and explain a wide range of phenomena; that is, the student:

- asks questions about objects, organisms, and events in the world;
- seeks information from reliable sources, including scientific knowledge, observation, and trying things out;
- uses evidence to construct an explanation; recognizes a fair test;
- recognizes others' points of view; checks his or her own and others' explanations against experiences, observations, and knowledge;
- identifies problems, proposes and implements solutions, evaluates products or designs;
- works individually and in teams to collect and share information and ideas.

MIDDLE SCHOOL

The student uses scientific reasoning strategies, scientific knowledge, and common sense to formulate questions about, understand, and explain a wide range of phenomena; that is, the student:

- frames questions so that causes and effects can be distinguished; identifies variables that influence a situation and can be controlled;
- uses concepts from Standards 1 to 4 to explain a variety of observations and phenomena;
- uses evidence to develop descriptions, explanations, and models;
- proposes, recognizes, analyzes, considers, and critiques alternative explanations; distinguishes between fact and opinion;
- identifies problems; proposes and implements solutions; evaluates products or designs;
- works individually and in teams to collect and share information and ideas.

HIGH SCHOOL

The student uses scientific reasoning strategies, scientific knowledge, and common sense to formulate questions about, understand, and explain a wide range of phenomena; that is, the student:

- frames questions so that causes and effects can be distinguished; identifies variables that influence a situation and can be controlled;
- formulates and revises explanations and models based on evidence and logical argument, preserving significant information;
- proposes, recognizes, analyzes, considers, and critiques alternative explanations; distinguishes between fact and opinion;
- identifies problems or design opportunities; proposes designs and chooses among alternatives; implements a solution and evaluates its consequences;
- works individually and in teams to collect and share information and ideas.

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6. Scientific Tools and Technologies

ELEMENTARY SCHOOL

The student uses tools and technologies to collect and analyze data; that is, the student:

- uses simple technology and tools to gather data and extend the senses, for example, rulers, balances, thermometers, watches, magnifiers, and microscopes;
- collects and analyzes data, using concepts and skills in Mathematics Standard 4, Statistics and Probability Concepts;
- acquires information from print and non-print sources.

MIDDLE SCHOOL

The student uses tools and technologies to collect and analyze data; that is, the student:

- uses a variety of traditional and electronic tools to directly, indirectly, and remotely observe and measure objects, organisms, and phenomena;
- records and stores data in a variety of formats, including databases, audiotapes, and videotapes;
- analyzes data, while alert to observer and sample biases, using concepts and skills from Mathematics Standard 4, Statistics and Probability Concepts;
- acquires information from print, electronic, and visual sources, including computer databases.

HIGH SCHOOL

The student uses tools and technologies to collect and analyze data; that is, the student:

- uses a variety of traditional and electronic tools to directly, indirectly, and remotely observe and measure objects, organisms, and phenomena, being alert to accuracy and precision;
- records and stores data in a variety of formats, including databases, audiotapes, and videotapes;
- analyzes data, taking steps to limit observer and sample biases, using concepts and skills from Mathematics Standard 4, Statistics and Probability Concepts;
- acquires information from print, electronic, and visual sources, including the Internet.

APPENDIX 3

The General Accounting Office recently reported that more than half of 10,000 schools surveyed lacked modems and phone lines, that only 35% of schools and 3% of classrooms currently have access to the Internet. We know this is an equity issue—that far more than 3% of the homes in the United States have access to the Internet and that schools must make sure that students' access to information and ideas does not depend on what they get at home. Standard 6, Scientific Tools and Technologies, includes using telecommunications to acquire and share information. New Standards' partners have pledged to create the learning environments where students can develop the knowledge and skills delineated here.

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7. Scientific Communication

The Grade Levels Compared: *Science*

APPENDIX 3

ELEMENTARY SCHOOL

The student communicates clearly and effectively about the natural world; that is,the student:

- represents data and results in more than one way, for example, numbers, drawings, words, tables;
- uses facts to support conclusions;
- critiques written and oral explanations;
- writes instructions that others can follow;
- communicates in a form suited to the purpose and the audience; uses data to resolve disagreements.

MIDDLE SCHOOL

The student communicates clearly and effectively about the natural world; that is, the student:

- represents data and results in multiple ways; for example, numbers and statistics; drawings, diagrams, and pictures; sentences; charts and tables; models;
- argues from evidence, including his or her own data and the data of others;
- critiques published materials;
- explains a scientific concept or procedure to other students;
- communicates in a form suited to the purpose and the audience; responds to critical comments with data.

HIGH SCHOOL

The student communicates clearly and effectively about the natural world; that is, the student:

- represents data and results in multiple ways; for example, numbers and statistics; drawings, diagrams, and pictures; sentences; charts and tables; models; and uses the most effective way to make the point;
- summarizes varied sources of evidence, including his or her own data and published reports;
- critiques published materials, including popular and academic sources;
- explains a scientific concept or procedure to other students;
- communicates in a form suited to the purpose and the audience; responds to critical comments with data and reasoning.

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ELEMENTARY SCHOOL

The student completes projects drawn from the following kinds of investigation, including at least one full investigation each year and, over the course of elementary school, investigations representing all four kinds.

- Experiment; that is, conducting a fair test;
- Systematic observation;
- Design;
- Research using print and electronic (that is, video or computer) information.

A single project may draw on more than one type of investigation.

A full investigation includes:

- questions that can be studied using the resources available;
- procedures that are safe, humane, and ethical; respect privacy and property rights;
- data that have been collected and recorded (see also Science Standard 6) in ways that others can verify, and analyzed using skills expected at this grade level (see also Mathematics Standard 4);
- data and results that have been represented (see also Science Standard 7) in ways that fit the context;
- recommendations, decisions, and conclusions based on evidence;
- acknowledgment of references and contributions of others;
- results that are communicated appropriately to audiences;
- reflection and defense of conclusions and recommendations from other sources and peer review.

MIDDLE SCHOOL

The student completes projects drawn from the following kinds of investigation, including at least one full investigation each year and, over the course of middle school, investigations representing all four kinds.

- Controlled experiment;
- Fieldwork;
- Design;
- Secondary research; that is, use of others' data.

A single project may draw on more than one type of investigation.

A full investigation includes:

- questions that can be studied using the resources available;
- procedures that are safe, humane, and ethical; respect privacy and property rights;
- data that have been collected and recorded (see also Science Standard 6) in ways that others can verify, and analyzed using skills expected at this grade level (see also Mathematics Standard 4);
- data and results that have been represented (see also Science Standard 7) in ways that fit the context;
- recommendations, decisions, and conclusions based on evidence;
- acknowledgment of references and contributions of others;
- results that are communicated appropriately to audiences;
- reflection and defense of conclusions and recommendations from other sources and peer review.

HIGH SCHOOL

The student completes projects drawn from the following kinds of investigation, including at least one full investigation each year and, over the course of high school, investigations representing all four kinds.

- Controlled experiment;
- Fieldwork;
- Design;
- Secondary research; that is, use of others' data.

A single project may draw on more than one type of investigation.

A full investigation includes:

- questions that can be studied using the resources available;
- procedures that are safe, humane, and ethical; respect privacy and property rights;
- data that have been collected and recorded (see also Science Standard 6) in ways that others can verify, and analyzed using skills expected at this grade level (see also Mathematics Standard 4);
- data and results that have been represented (see also Science Standard 7) in ways that fit the context;
- recommendations, decisions, and conclusions based on evidence;
- acknowledgment of references and contributions of others;
- results that are communicated appropriately to audiences;
- reflection and defense of conclusions and recommendations from other sources and peer review.

APPENDIX 3

Best practice in Science has always included extensive inquiry and investigation, but it is frequently given less emphasis at the elementary and middle school levels. There are many opportunities to learn Science outside of school, including Scouts, Boys and Girls Clubs, 4-H and Future Farmers of America. The work done in these venues can and should be used to provide evidence of meeting the standards.

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APPENDIX 4

The elementary school standards are set at a level of performance approximately equivalent to the end of fourth grade. The middle school standards are set at a level of performance approximately equivalent to the end of eighth grade. The high school standards are set at a level of performance approximately equivalent to the end of tenth grade. It is expected that some students might achieve these levels earlier and others later than these grades.

The standards for Applied Learning have been revised substantially since the last published draft of these Performance Standards. Contact New Standards for information about the content framework that has provided the foundation for the Applied Learning standards.

ELEMENTARY SCHOOL

The student completes projects involving at least two of the following kinds of problem solving each year and, over the course of elementary school, projects involving all three kinds of problem solving.

- Designing: identifying needs that could be met by new products, services, or systems; and creating solutions for meeting them;
- Planning and Organizing: taking responsibility for all aspects of planning and organizing an event or activity from concept to completion, making good use of the resources of people, time, money, and materials and facilities;
- Improving a System: developing an understanding of the way systems of people, machines, and processes work; troubleshooting problems in their operation; and devising strategies for improving their effectiveness.

A single project may involve more than one kind of problem solving.

Designing

The student designs a product, service, or system to meet an identified need; that is, the student:

- develops ideas for design of the product, service, or system;
- identifies factors affecting choice of the best idea for the design and makes a decision based on those factors;
- selects and uses an appropriate form for presenting the design plan;
- establishes criteria for judging the success of the design;
- plans and carries out the steps of the production process;
- evaluates the quality of the design by considering the criteria for success and by comparison with similar products, services, or systems.

Planning and Organizing

The student plans and organizes an event or activity; that is, the student:

- develops a plan that:
  - includes all the factors and variables that need to be considered;
  - makes sense in terms of the order in which things need to be done;
  - makes sense in terms of the people, time, and resources available to put the plan into action;
  - is described clearly enough for someone else to use it;
- implements the plan;
- evaluates the success of the event or activity, identifying the parts of the plan that worked best and the aspects that could have been improved by better planning and organization, and proposing how the improvements could have been achieved;
- makes recommendations to others who might consider planning and organizing a similar event or activity.

Improving a System

The student troubleshoots problems in the operation of a system in need of repair or devises and tests ways of improving the effectiveness of a system in operation; that is, the student:

- identifies the parts of the system and the way the parts connect with each other;
- identifies parts or connections in the system that have broken down or that could be made to work better;
- devises ways of making the system work again or making it work better;
- checks whether the strategies worked.

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MIDDLE SCHOOL

The student completes projects involving at least two of the following kinds of problem solving each year and, over the course of middle school, projects involving all three kinds of problem solving.

- Designing: identifying needs that could be met by new products, services, or systems; and creating solutions for meeting them;
- Planning and Organizing: taking responsibility for all aspects of planning and organizing an event or activity from concept to completion, making good use of the resources of people, time, money, and materials and facilities;
- Improving a System: developing an understanding of the way systems of people, machines, and processes work; troubleshooting problems in their operation; and devising strategies for improving their effectiveness.

A single project may involve more than one kind of problem solving.

Designing

The student designs a product, service, or system to meet an identified need; that is, the student:

- develops a range of design options;
- selects one design option to pursue and justifies the choice, for example, with reference to functional, aesthetic, social, economic, or environmental considerations;
- identifies, where relevant, the principles on which the decision was based, such as aesthetic, mathematical, scientific;
- uses appropriate conventions to represent the design;
- establishes criteria for judging the success of the design;
- plans and carries out the steps of the production process;
- adjusts the production process as required to achieve specified standards of quality and safety;
- evaluates the quality of the design by considering the criteria for success and by comparison with similar products, services, or systems.

Planning and Organizing

The student plans and organizes an event or activity; that is, the student:

- develops a plan that:
  - reflects research into relevant precedents and regulations;
  - includes all the factors and variables that need to be considered;
  - makes sense in terms of the order in which things need to be done;
  - makes sense in terms of the people, time, and resources available to put the plan into action;
  - is described clearly enough for someone else to use it;
- implements the plan in ways that:
  - reflect established priorities;
  - respond effectively to unforeseen circumstances;
- evaluates the success of the event or activity, identifying the parts of the plan that worked best and the aspects that could have been improved by better planning and organization, and proposing how the improvements could have been achieved;
- makes recommendations to others who might consider planning and organizing a similar event or activity.

Improving a System

The student troubleshoots problems in the operation of a system in need of repair or devises and tests ways of improving the effectiveness of a system in operation; that is, the student:

- describes the management and structure of the system in terms of its logic, sequences, and control;
- identifies the operating principles underlying the system, i.e., mathematical, scientific, organizational;
- analyzes the design and management of the system with reference to its functional, aesthetic, social, commercial, and environmental requirements, as appropriate;
- evaluates the operation of the system;
- devises strategies for putting the system back in operation or improving its performance;
- tests the effectiveness of the strategies employed.

HIGH SCHOOL

The student completes projects involving at least two of the following kinds of problem solving each year and, over the course of high school, projects involving all three kinds of problem solving.

- Designing: identifying needs that could be met by new products, services, or systems, and creating solutions for meeting them;
- Planning and Organizing: taking responsibility for all aspects of planning and organizing an event or activity from concept to completion, making good use of the resources of people, time, money, and materials and facilities;
- Improving a System: developing an understanding of the way systems of people, machines, and processes work; troubleshooting problems in their operation; and devising strategies for improving their effectiveness.

A single project may involve more than one kind of problem solving.

Designing

The student designs a product, service, or system to meet an identified need; that is, the student:

- develops a design proposal that:
  - shows how the ideas have been developed;
  - reflects awareness of similar work done by others and of relevant design standards and regulations;
  - justifies the choices made, for example, with reference to functional, aesthetic, social, economic, and environmental considerations;
  - describes, where relevant, the principles on which decisions were based, such as aesthetic, mathematical, and scientific;
  - establishes criteria for evaluating the product, service, or system;
  - uses appropriate conventions to represent designs;
  - communicates clearly so that a peer or colleague could use it;
- organizes, implements, and adjusts the production process to:
  - achieve specified standards of quality and safety;
  - make efficient use of time and resources;
- evaluates the product, service, or system in terms of the criteria established in the design proposal, using:
  - information gathered from impact studies or product testing or market research, as appropriate;
  - comparisons with similar work done by others.

Planning and Organizing

The student plans and organizes an event or activity; that is, the student:

- develops a planning schedule that:
  - is sensible in terms of the goals of the event or activity;
  - is logical and achievable;
  - reflects research into relevant precedents and regulations;
  - takes account of all relevant factors;
  - reflects strategic thinking;
  - communicates clearly so that a peer or colleague could use it;
- implements and adjusts the planning schedule in ways that:
  - achieve specified standards of quality;
  - make efficient use of time, money, people, resources, facilities;
  - reflect established priorities;
  - respond effectively to unforeseen circumstances;
- evaluates the event or activity using qualitative and quantitative methods to determine:
  - the success of the event or activity in terms of its established purposes;
  - aspects of the event or activity that could have been improved by better planning and organization and the ways by which the improvements could have been achieved;
  - recommendations for planning and organizing subsequent similar events or activities.

Improving a System

The student troubleshoots problems in the operation of a system in need of repair or devises and tests ways of improving the effectiveness of a system in operation; that is, the student:

- explains the management and structure of the system in terms of its:
  - logic, sequences, and control;
  - impact;
  - operating principles, that is, the mathematical, scientific and/or organizational principles underlying the system;
- analyzes the design and management of the system, taking account of its functional, aesthetic, social, environmental, and commercial requirements, as appropriate, and using a relevant kind of modeling and systems analysis;
- evaluates the operation of the system using qualitative methods and/or quantitative measurements of performance;
- adapts techniques to control and manage the system in order to improve its performance by:
  - identifying, testing, and adjusting sub-systems;
  - developing and testing strategies to optimize performance.

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APPENDIX 4

ELEMENTARY SCHOOL

The student makes an oral presentation of project plans or findings to an appropriate audience; that is, the student:

- organizes the presentation in a logical way appropriate to its purpose;
- speaks clearly and presents confidently;
- responds to questions from the audience;
- evaluates the effectiveness of the presentation.

The student composes and sends correspondence, such as thank-you letters and memos providing information; that is, the student:

- expresses the information or request clearly;
- writes in a style appropriate to the purpose of the correspondence.

The student writes and formats information for short publications, such as brochures or posters; that is, the student:

- collects information to include in the publication;
- organizes the information into an appropriate form for use in the publication;
- checks the information for accuracy;
- formats the publication so that it achieves its purpose.

The student translates information from one format to another; that is, the student:

- chooses a different format that is appropriate for presenting information to better suit the purpose for communicating it;
- checks that the information has been translated accurately into the new format;
- gives reasons for any changes made in the information, such as deciding to leave some information out.

MIDDLE SCHOOL

The student makes an oral presentation of project plans or findings to an audience beyond the school; that is, the student:

- organizes the presentation in a logical way appropriate to its purpose;
- adjusts the style of presentation to suit its purpose and audience;
- speaks clearly and presents confidently;
- responds appropriately to questions from the audience;
- evaluates the effectiveness of the presentation.

The student conducts formal written correspondence with a community organization or business; that is, the student:

- expresses the information or request clearly for the purpose and audience;
- writes in a style appropriate to the purpose and audience of the correspondence.

The student organizes and communicates information for publication using several methods and formats, such as overhead transparencies, handouts, and computer generated graphs and charts; that is, the student:

- collects information to include in published materials;
- organizes the information into an appropriate form for use in the publication, taking account of the requirements and possibilities of the chosen format;
- checks the information for accuracy;
- formats the published material so that it achieves its purpose.

The student translates information from one format to another; that is, the student:

- chooses a different format that is appropriate for presenting information to better suit the purpose for communicating it;
- checks that the information has been translated accurately into the new format;
- gives reasons for any changes made in the information, such as deciding to leave some information out.

HIGH SCHOOL

The student makes an oral presentation of project plans or findings to an audience with expertise in the relevant subject matter; that is, the student:

- organizes the presentation in a logical way appropriate to its purpose;
- adjusts the style of presentation to suit its purpose and audience;
- speaks clearly and presents confidently;
- responds appropriately to questions from the audience;
- evaluates the effectiveness of the presentation.

The student prepares a formal written proposal or report to a community organization or business; that is, the student:

- organizes the information in the proposal or report in a logical way appropriate to its purpose;
- produces the proposal or report in a format similar to that used in professionally produced documents for a similar purpose and audience.

The student develops a multi-media presentation, combining text, sound, and images; that is, the student:

- selects an appropriate medium for each element of the presentation;
- uses the selected media skillfully, including editing and monitoring for quality;
- makes smooth transitions between the elements of the presentation;
- achieves coherence in the presentation as a whole;
- communicates the information effectively, testing audience response and revising the presentation accordingly.

The student translates information from one format to another; that is, the student:

- chooses a different format appropriate for presenting information to better suit the purpose for communicating it;
- checks that the information has been translated accurately into the new format;
- justifies any changes made in the information, including the omission of material irrelevant to the purpose of the communication.

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3. Information Technology Tools and Techniques

The Grade Levels Compared: *Applied Learning*

APPENDIX 4

ELEMENTARY SCHOOL

The student:

- uses word processing, graphics, and drawing programs;
- uses an electronic card catalogue.

MIDDLE SCHOOL

The student:

- loads, runs, and uses database and spreadsheet programs;
- acquires information for specific purposes from on-line sources;
- uses documentation and on-screen help to learn how to use software programs.

HIGH SCHOOL

The student:

- sets up and operates computer equipment and associated peripherals;
- troubleshoots problems in operating computer equipment and software;
- uses on-line sources to exchange information for specific purposes.

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ELEMENTARY SCHOOL

The student learns from role models; that is, the student:

- consults with or observes older students and adults at work and identifies the main features of what they do, the way they go about their work, and the qualities of the products they produce;
- takes account of role models in planning and conducting his or her own project activities.

The student keeps records of work activities in an orderly manner; that is, the student:

- sets up a system for storing records of work activities;
- maintains records of work activities in a way that makes it possible to find specific materials quickly and easily.

The student identifies strengths and weaknesses in his or her own work; that is the student:

- understands and establishes criteria for judging the quality of work processes and products;
- assesses his or her own work processes and products.

MIDDLE SCHOOL

The student learns from role models; that is, the student:

- consults with or observes older students and adults at work and identifies the main features of what they do, the way they go about their work, and the qualities of the products they produce;
- analyzes work performances and work products to identify factors affecting success;
- takes account of analyses of role models in planning and conducting his or her own project activities.

The student develops and maintains a schedule of work activities; that is, the student:

- establishes a schedule of work activities that reflects priorities and deadlines;
- seeks advice on the management of conflicting priorities and deadlines;
- updates the schedule regularly.

The student sets goals for learning and reviews his or her progress; that is, the student:

- sets goals for learning;
- reviews his or her progress towards meeting the goals;
- seeks and responds to advice from others in setting goals and reviewing progress.

HIGH SCHOOL

The student learns from adult role models; that is, the student:

- consults with and observes adult role models at work and identifies the elements of their work roles and the qualities of the their work products;
- analyzes the work performance of adult role models to determine the critical demands of the role, such as demands for knowledge and skills, judgment and decision making;
- takes account of analyses of role models in planning and conducting his or her own project activities.

The student reviews his or her own progress in completing work activities and adjusts priorities as needed to meet deadlines; that is, the student:

- develops and maintains work schedules that reflect consideration of priorities;
- manages time;
- monitors progress towards meeting deadlines and adjusts priorities as necessary.

The student evaluates his or her performance; that is, the student:

- establishes expectations for his or her own achievement;
- critiques his or her work in light of the established expectations;
- seeks and responds to advice and criticism from others.

APPENDIX 4

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APPENDIX 4

ELEMENTARY SCHOOL

The student works with others to complete a task; that is, the student:

- reaches agreement with group members on what work needs to be done to complete the task and how the work will be tackled;
- takes a share of the responsibility for the work;
- consults with group members regularly during the task to check on progress in completing the task, to decide on any changes that are required, and to check that all parts have been completed at the end of the task.

The student shows or explains something clearly enough for someone else to be able to do it.

The student identifies the needs of a client; that is, the student:

- interprets a written request for completion of a task;
- asks questions to clarify the demands of a task.

MIDDLE SCHOOL

The student takes responsibility for a component of a team project; that is, the student:

- reaches agreement with team members on what work needs to be done to complete the task and how the work will be tackled;
- takes specific responsibility for a component of the project;
- takes all steps necessary to ensure appropriate completion of the specific component of the project within the agreed upon time frame.

The student coaches or tutors; that is, the student:

- assists one or more others to learn on the job, e.g., in school, sports, and community groups;
- analyzes coaching or tutoring experience to identify more and less effective ways of providing assistance to support on-the-job learning;
- uses the analysis to inform subsequent coaching or tutoring activities.

The student negotiates with a client; that is, the student:

- consults with a client to clarify the demands of a task;
- interprets the client's request and translates it into an initial plan for completing the task, taking account of available resources;
- negotiates with the client to arrive at an agreed upon plan.

HIGH SCHOOL

The student participates in the establishment and operation of self-directed work teams; that is, the student:

- identifies the range of knowledge and skills required for a given project;
- defines roles and shares responsibilities among team members;
- sets objectives and time frames for the work to be completed;
- establishes processes for group decision making;
- reviews progress and makes adjustments as required.

The student plans and carries out a strategy for introducing others into a work program; that is, the student:

- establishes learning goals;
- plans a sequence of activities designed to achieve the learning goals;
- monitors the learning process and revises activities accordingly;
- evaluates the success of the strategy and identifies aspects of the process that could have been improved and the ways by which the improvements could have been achieved.

The student completes a task in response to a commission from a client; that is, the student:

- negotiates with the client to arrive at a plan for meeting the client's needs that is acceptable to the client, achievable within available resources, and includes agreed-upon criteria for successful completion;
- monitors client satisfaction with the work in progress and makes adjustments accordingly;
- evaluates the result in terms of the negotiated plan and the client's evaluation of the result.

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STANDARDS DEVELOPMENT STAFF

Ann Borthwick, Learning Research and Development Center, University of Pittsburgh

Bill Calder, Fort Worth Independent School District, TX

Shannon C'de Baca, Thomas Jefferson High School, Council Bluffs, IA

Janet Coffey, Edmund Burke School, Washington, DC

Duane A. Cooper, Center for Mathematics Education and Department of Mathematics, University of Maryland

Phil Daro, Academic Advancement, University of California Office of the President

Diana Edwards, Learning Research and Development Center, University of Pittsburgh

Gary Eggan, Learning Research and Development Center, University of Pittsburgh

Sally Hampton, Fort Worth Independent School District, TX

Drew Kravin, Cornell Elementary School, Albany, CA

Georgia Makris, Academic Advancement, University of California Office of the President

Mary Marsh, Fort Worth Independent School District, TX

Kate Nolan, Learning Research and Development Center, University of Pittsburgh

Andy Plattner, National Center on Education and the Economy

Lonny Platzer, Learning Research and Development Center, University of Pittsburgh

Jennifer Quinn, Fort Worth Independent School District, TX

Mark Rasmussen, Cornell Elementary School, Albany, CA

Ann Shannon, Graduate School of Education, University of California at Berkeley

Liz Spalding, National Council of Teachers of English

Elizabeth Stage, Academic Advancement, University of California Office of the President

Dick Stanley, Dana Center, University of California at Berkeley

Cathy Sterling, Academic Advancement, University of California Office of the President

John Tanner, Fort Worth Independent School District, TX

Ginny Van Horne, Education and Human Resources, American Association for the Advancement of Science

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Peter Afflerbach, University of Maryland

Bob Anderson, Department of Education, CA

Laura Arndt, Eaglecrest High School, Aurora, CO

Rob Atterbury, San Diego City Schools, CA

Jerry Bell, Education and Human Resources, American Association for the Advancement of Science

Neal Berkin, White Plains Schools, White Plains, NY

Victoria Bill, Institute for Learning, Learning Research and Development Center, University of Pittsburgh

Ruben Carriedo, San Diego City Schools, CA

Linda Carstens, San Diego City Schools, CA

Miriam Chaplin, National Council of Teachers of English

Lynda Chittenden, Park Elementary, Mill Valley, CA

Fran Claggett

Marsha DeLain, Delaware Department of Public Instruction

Xandra Williams Earlie, Aldine Independent School District, Houston, TX

Joanne Eresh, Pittsburgh Public Schools, PA

Ed Esty, Independent Consultant, Chevy Chase, MD

Alan Farstrup, International Reading Association

Karen Fujii, Bucher Middle School, Santa Clara, CA

Matt Gandal, American Federation of Teachers

Chris Gee, Vermont *Times Argus*

Karrie Gengo, Meadowdale High School, Lynnwood, WA

Stacy Goodman, Lewis Central Schools, Council Bluffs, IA

Eunice Greer, University of Illinois

Mike Hale, Council Bluffs Community Schools, Council Bluffs, IA

Shirley Brice Heath, Stanford University

Bill Honig, San Francisco State University

Beth Hulbert, Ward 5, Barre, VT

Tom Jones, National Alliance for Restructuring Education

Nancy Kellogg, CONNECT, Colorado Department of Education

Don King, Department of Mathematics, Northeastern University

Linda Lewis, Fort Worth Independent School District, TX

Bob Livingston, Pennsylvania Department of Education

Gary MacDonald, Junior High School, Greely, CO

Shirley Malcom, American Association for the Advancement of Science

Megan Martin, California Department of Education

Rich Matthews, Pittsburgh Public Schools, PA

Jim Meadows, Mountlake Terrace High School, Mountlake Terrace, WA

Monty Multanen, Edmonds School District, WA

Miles Myers, National Council of Teachers of English

Lee Odell, Rensselaer Polytechnic Institute, Troy, NY

Gary Oden, Institute for Learning, Learning Research and Development Center, University of Pittsburgh

Kevin Padian, Department of Integrative Biology, University of California at Berkeley

David Pearson, Michigan State University

Charles Peters, Oakland Michigan Schools

Marge Petit, Vermont Institute for Mathematics, Science, and Technology

Cindy Phillips, Tri City Elementary, Myrtle Creek, Oregon

John Porter, National Alliance for Restructuring Education

Robert Probst, University of Georgia

Fred Quinonez, Overland Trail Middle School, Brighton, CO

Susan Radley, Teachers College Writing Project at Columbia University, NY

Ginny Redish, Redish & Associates, Inc.

Eeva Reeder, Mountlake Terrace High School, Mountlake Terrace, WA

Don Rubin, University of Georgia

Robert Rueda, University of Southern California

Marge Sable, National Alliance for Restructuring Education

Sandy Short, Hillview Crest Elementary School, New Haven Unified School District, CA

Sandy Smith, Harrison High School, Aurora, CO

Dave Steward, John Evans Jr. High School, Greely, CO

John Swang, National Science Research Center, Mandeville, LA

Carol Tateishi, Bay Area Writing Project

Johnny Tolliver, Delaware State University

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Ann Tweed, Eaglecrest High School, Aurora, CO
John Vibber, Mt. Abraham Union High School, Briston, VT
Darby Williams, Sacramento County Office of Education, CA
Dale Vigil, San Diego City Schools, CA
Dennie Wolf, Harvard PACE
Victoria Young, Texas Education Agency

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700 Eleventh Street, NW • Suite 750 • Washington, DC 20001
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